Journal of Modern Research in English Language Studies
Print ISSN: 2676-5357
Online ISSN: 2676-5985

# Instructional Scaffolding in Online Content-based Instruction: Intentions of Teachers' Scaffolding

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**Article Info**

**Article Type:**

**Research Article**

**Received:**

**27/06/2022**

**Accepted:**

**15/08/2022**

**ABSTRACT**

The emerging interest in scaffolding as a dynamic, multifaceted, and evolving construct has mounted over the last decades due to its impact on teachers' professional development and students' learning. The present paper adopted conversation analysis to analyze scaffolding intentions in content-based instruction (CBI) based on Van de Pol et al.'s (2010) framework of scaffolding intentions, which includes direction maintenance, cognitive structuring, reduction of the degrees of freedom, recruitment, and frustration control. Through convenience sampling, four science teachers in English-medium CBI were selected, and the videotaped recordings of 12 hours of their online classroom instruction were transcribed and analyzed. The findings indicated that scaffolding intentions mostly pertain to enhancing students' cognitive structuring, controlling their frustration, and promoting their engagement in the learning process. The findings showed that the cognitive load of learning concepts was one of the main determiners of teachers' scaffolding. Also, various activities to recruit interest were used by the teachers to provide scaffolding. The findings evidenced that teachers' interactional and instructional techniques were mostly centered on directing students towards the pedagogical aims and engaging them in the various activities at hand to call students' attention to the applicability of science matters in the real-life or personal experience. In this study, developing self-supporting and self-reflecting strategies was found to be demanding for the teachers. These findings have implications for the teachers and teacher educators to heighten teachers' awareness of scaffolding in CBI classes to enact more effective teaching.

***Keywords:*** Scaffolding Intentions, Content-Based Instruction (CBI), International Students, Online Classes, Conversation Analysis

**Cite this article:** Kamrani, Z., Tajeddin, Z., & Alemi, M. (2023). Instructional Scaffolding in Online Content-based Instruction: Intentions of Teachers' Scaffolding. *Journal of Modern Research in English Language Studies, 10*(1), 73-99.

DOI: 10.30479/jmrels.2022.17467.2087

## 1. Introduction

Educational Scaffolding is construed as sufficient, adjustable, and temporal support to promote learning, which is reduced gradually until the students get independent and autonomous (Omoniyi & Torru, 2018). Situated within sociocultural theory, the concept of scaffolding is considered an instructional strategy provided by a more able peer or the teacher to complete tasks beyond the learners' capabilities (Smagorinsky, 2018). Scaffolding has been widely applied as a conducive and constructive tool for effective teaching. Great attention has been devoted to scaffolding in the studies on teachers' professional development and students' learning (e.g., Echevarría et al., 2017; Mahan, 2020; Reynolds, 2017; Smagorinsky, 2018; Tajeddin & Kamali, 2020). Current trends show that scaffolding has become increasingly popular due to its practicality in students' learning and cognition development in social or culturally embedded experiences (Belland et al., 2017). Thus, the critical criterion couched in the employment of scaffolding results in the underlying learners' independency, self-regulation, and problem-solving. Scaffolding intentions refer to the purposes and goals of assisting in extending the students' ZPD to higher levels. The focal aim of scaffolding intention is on the goals of provided scaffolding techniques, which are mainly discussed by answering what is scaffolded. According to Van de Pol et al. (2010), scaffolding intentions mainly focus on what is scaffolded by clarifying the underlying reasons. By analyzing scaffolding intentions, Van de Pol et al. (2010) categorized five goals of scaffolding: direction maintenance, cognitive structuring, recruitment, contingency management, and reduction of degrees of freedom. What is unknown, albeit relevant to know, is to identify teachers' intentions for supporting students' language and content knowledge development in a classroom and, consequently, the types of strategies and techniques teachers apply during the process.

Due to the significance of effective teaching, education has experienced an extensive increase in the number of studies on scaffolding in various educational contexts. Findings from the previous studies on scaffolding are inconclusive due to their variation, inconsistency, and even conflict in conceptualizations in diverse contexts (Belland et al., 2017; Kim et al., 2018; Li & Zhang, 2020; Mahan, 2020; van de Pol et al., 2011; van Kampen et al., 2018). Despite the body of research conducted on scaffolding and its functions in the various educational contexts, a small number of studies have focused on scaffolding in content-based instruction (CBI) (e.g., Cammarata & Ceallaigh, 2018; Hamidi & Bagherzadeh, 2018; Mahan, 2020; Tajeddin et al., 2020; van Kampen et al., 2018). In content-based instruction (CBI), the aim is teaching content subjects through a language other than learners' L1 (Stoller, 2008), so CBI is defined as integrating particular content with language teaching aims. The question in CBI is how students

can be effectively support students in learning both content and language knowledge (Cummins & Early, 2015; Daniels, 2016; Mahan, 2020; Troyan et al., 2017). Furthermore, it should be noted that CBI teachers need to scaffold not only content and language knowledge, but also develop academic skills to function well in a higher education context. Consequently, the concept of scaffolding in CBI contexts has become the center of attention for numerous reasons such as teachers' pedagogical knowledge and skills, the abstract, qualitative, extremely interpretable, and non-statistical nature of scaffolding, types and quality of materials, the priority of language or content knowledge, and evaluation in CBI classes (Awan & Sipra, 2018; Hamidi & Bagherzadeh, 2018; Mahan, 2020; Stoller & Fitzsimmons-Doolan, 2017). Despite the proliferation of studies on educational scaffolding, scaffolding in CBI does not have robust literature, and hence more empirical studies should be carried out to show how CBI teachers integrate scaffolding into their instructional practice (Cammarata & Ceallaigh, 2018; Daniels, 2016; Li & Zhang, 2020; Mahan, 2020; Mahan et al., 2018; Tajeddin et al., 2020; van Kampen et al., 2018). Thus, there is a clear need for research on teachers' scaffolding intentions in English-medium content-based instruction (CBI) while considering both dimensions, that is content and language knowledge. The main aim of this study was to fill this gap by exploring CBI teachers' scaffolding intentions in the context of international schools in Iran, where English is used as a medium of instruction.

## 2. Literature Review

### 2.1. Scaffolding

Scaffolding is a 'process by which tutors– parents, caretakers, teachers, or more expert partners– help someone less skilled solve a problem' (De Guerrero & Villamil, 2000, p. 52). Therefore, scaffolding, as an effective assisted support given, is provided by teachers or experienced peers to less knowledgeable students to achieve their potential level throughout the learning process (Rassaei, 2014; Smit & Van Eerde, 2013; Van de Pol et al., 2011). This interactive process would lead students to deeper learning, motivation, and independency and to successfully solve a problem, do a task, or achieve a goal beyond their capacity (Belland, 2014; Pea, 2004; Sharma & Hannafin, 2007). These instructional techniques, which stem from the socio-constructivist model, promote a deeper level of learning than many other common teaching strategies pursue (Vygotsky, 1978). Scaffolding, which is jointly co-constructed and contingent on the students' needs, is provided at the point of need and efficiently develops cognitive and metacognitive abilities. Scaffolding can help students move gradually toward the stronger and next level of learning but should be gradually decreased with the purpose

of students' self-regulation. This indicates that the responsibility is gradually shifted to the students whilst the teachers slowly withdraw the support provided. Teachers' calibrated and adaptive scaffolding develops metacognitive activities, and cognitive activities, and foster engagement. Subsequently, the students can become self-regulating, which results in greater independency in the learning process (Omoniyi & Torru, 2018).

As the literature reveals, scaffolding has gained widespread popularity in a variety of research in educational contexts (e.g., Azir & Sriyanto, 2021; Bataineh & Obeiah, 2016; Doo et al., 2020; Mahan, 2020; Tajeddin & Kamali, 2020; Tajeddin et al., 2020). As the literature reveals, a number of studies have documented the impacts of scaffolding on various language skills and components or the types and features of scaffolding strategies and techniques. Wette (2014), for instance, conducted a study on the role of teachers' scaffolding on writing skills. The findings showed that teachers' scaffolding positively impacted students' academic writing. In another study, Reynolds (2017) investigated students' reading comprehension by enacting various scaffolding strategies and principles, which resulted in a significant impact. In a large-corpus-based study, Tajeddin and Kamali (2020) developed a new typology of scaffolding in the language classroom. The study results revealed four significant categories: meta-scaffolding, linguistic scaffolding, affective scaffolding, and under-scaffolding. Making a distinction between scaffolding intentions and means, Van de Pol et al. (2010) conducted a study to look more precisely at interactions resulting in more nuanced descriptions of teacher-student interactions. Scaffolding means indicate how scaffolding is taking place, while scaffolding intentions focus on underlying reasons for scaffolding the items (Van de Pol et al., 2010). By analyzing the scaffolding intentions, five goals of scaffolding have been categorized by Van de Pol et al. (2010), namely direction maintenance, cognitive structuring, recruitment, contingency management, and reduction of degrees of freedom. By direction maintenance, the teacher keeps the students in pursuit of a particular objective or overall learning goal, which is dependent on the nature of content knowledge, students' characteristics, and their proficiency level (Li & Zhang, 2020; Heron & Webster, 2018; Tajeddin et al., 2020). This meta-cognitive scaffolding helps students self-reflect on their knowledge and skills, monitor their progress (Belland, 2017), and assess and promote their online comprehension required for turning to the next task (Buenner, 2013; Heron & Webster, 2018). In addition, direction maintenance entails keeping the learning on target through students' enduring effort (Holton & Clarke, 2006; Nguyen & Williams, 2019; Radford et al., 2014).

Through cognitive structuring, as the second type of scaffolding intention, the teacher provides explanations to foster student cognition. This scaffolding intention would be supporting for students' cognitive processing, belief organization, and rationalizations (Baxter & Williams, 2010).

Cognitive scaffolding aids students in constructing cognition via strategies like providing hints (Cunningham & Lachapelle, 2016), modeling and explaining (Nguyen & Williams, 2019), and challenging tasks (Li & Zhang, 2020). The third scaffolding intention, recruiting the student's interest in the activities, refers to students' engaging and supporting task-oriented participation. Teachers mostly recruited interest in the learning process by awarding points such as watching movies, playing various games, working in pairs and groups, and modeling at the end of the practicum to encourage and entertain students to follow up the learning (Buenner, 2013; Tajeddin et al., 2020). In addition, it enhances student-teacher interaction in educational contexts (Belland et al., 2013; Tajeddin et al., 2020).

Contingency management (Frustration Control), the fourth scaffolding intention, aims at minimizing frustration and making situations less risky, demanding, and threatening to keep students working on activities. This practical and contingent scaffolding intention is dependent on students' needs and circumstances (Heron & Webster, 2018; Li & Zhang, 2020; Nguyen & Williams, 2019). This ensures that teachers give feedback contingent on the current needs of the students or their errors (van de Pol et al., 2010). This scaffolding intention involves maintaining through questioning, clarification, hint, rephrasing, explanation, and visual aids (Tajeddin et al., 2020). As the last scaffolding intention, reduction degree of freedom aims to reduce the number of available acts, develop the activities and concepts around manageable components, and help students use learnable units with a considerable degree of effectiveness. It is provided when students fail to learn something new or to do tasks. This scaffolding intention entails simplification of the tasks responsive to students' needs although it hinders students' autonomy and cognitive development in their learning process (Gibbons, 2015; Li & Zhang, 2020; Tajeddin et al., 2020).

## 2.2. Content-based Instruction

Content-based instruction (CBI) has received much interest as one of the instructional methodologies in the instruction of both language skills and content knowledge through a non-L1 medium of instruction (Cammarata et al., 2016). Grabe and Stoller (2019) defined CBI as "Instructional approaches that make a dual, but not necessarily equal, commitment to language and content learning" (p. 13). CBI shares similar principles and characteristics with other prominent teaching approaches such as communicative language teaching (CLT) and content and language integrated learning (CLIL) (Brinton & Snow, 2017; Hammu & Kesbi, 2021; Juan-Garau & Salazar-Noguera, 2015; Morton & Llinares, 2016; Ruiz de Zarobe & Zenotz, 2017). Previous studies have shown detrimental challenges of CBI/CLIL in educational contexts (Awan & Sipra, 2018; Li & Zhang, 2020; Mahan, 2020; Ní Chróinín

et al., 2016; Tajeddin et al., 2020) as teachers' qualification, curriculum, the priority of language or content knowledge, and assessment in CBI classes (Awan & Sipra, 2018; Hammu & Kesbi, 2021; Mahan et al., 2018; Stoller & Fitzsimmons-Doolan, 2017; Tajeddin et al., 2020; van Kampen et al., 2018; Vinita & Ilankumaran, 2020).

A line of research has been carried out to investigate the efficacy of content-based instruction. Recently, Vanichvasin (2019) found that CBI could be used as an effective methodology and essential aid in generating opportunities to use English, which resulted in increased English language performance. Furthermore, it was found that CBI helped students practice, have a better attitude, and gain more confidence to express themselves in English. It was discovered that the CBI group significantly outperformed the others. Khruawan and Dennis's (2017) study uncovered that the effectiveness of English reading after using a CBI approach to teaching was significantly greater than before teaching and the students had a positive attitude toward using the CBI approach. In another study, Adawiyah's (2018) research explored the effectiveness of content-based instruction in teaching speaking skills to learners of English as foreign language (EFL). The findings revealed that content-based instruction was an effective method of teaching speaking. By recognizing the relationship between languages and content and acquiring the academic language, the efficacy of language input via content subject teaching can be enhanced (Linares et al., 2012).

Despite the body of research on scaffolding, a few studies have been carried out on scaffolding in CBI classes (Li & Zhang, 2020; Lo & Lin, 2019; Lo et al., 2019; Mahan, 2020; Tajeddin et al., 2020;). Lo et al. (2019), for example, conducted a study to scrutinize science teachers' scaffolding on instructional and assessment practices. What seemed interesting was that two teachers were concerned about different lesson objectives, one of the teachers focused on language knowledge, and the other tended to highlight content knowledge while scaffolding. Li and Zhang (2020) also investigated the influence of teachers' scaffolding on intensive reading in English-medium instruction. The results of the study demonstrated that teachers' scaffolding positively impacted on students' learning and comprehension. Mahan (2020), on the other hand, ran a study on the teaching three different subjects, science, English, and mathematics. The findings revealed that although understanding scientific concepts was the primary goal of teachers' scaffolding, the nature of the content subjects verified the types of scaffolding strategies. Tajeddin et al. (2020), likewise, set out a study on teachers' discursive scaffolding strategies and functions in science CBI. The results showed that the teachers' ultimate goals were the students' cognitive development and applicability of this concept in real-life experiences.

Despite the increase in the studies of scaffolding arising from classroom interaction, its goals or intentions require further exploration of

teachers' scaffolding practices. Furthermore, there are still many open questions about various teachers' scaffolding intentions to apply strategies and techniques in supporting student learning. In line with this, the goal of the present study was to explore the teachers' scaffolding intentions in an English-mediated CBI. To this aim, the following research question was formulated:

RQ: What are scaffolding intentions employed by teachers in English-medium content-based education?

## 3. Method

### 3.1. Participants and Setting

This qualitative descriptive study was undertaken at an international school in Iran. Participants included four female science teachers in private school classrooms in Tehran. The teachers were selected following a convenience sampling method and based on their being experienced and available at the time. They held B.A., M.A., and Ph.D. degrees with 6 to 15 years of continued teaching experience at different proficiency levels and contexts. There were two fifth-graders classes and two sixth-graders classes, each with approximately 13 students in this international school. There were around 50 participating female students with a variety of native languages. The students were all aged between 10-12 and passed the same courses. Each class had four 45-minute lessons per week, with the focus on sciences through online English-medium instruction. Since the number of students was low, the classroom context was primarily interactive and engaging.

International schools are popular among students who wish to be qualified for higher education or employment in foreign countries. Therefore, these schools prepare students to become global citizens. In these schools, students can be transferred across international schools around the world through special rules, so there is non-selective student enrollment. The international school was mainly a private school that operated independently from the Ministry of Education and used international curricula, such as the International Baccalaureate, Edexcel, and Cambridge Assessment International Education, which are mostly different from the national curriculum. The aims of the international schools are: to promote international education in an international environment like the Council of British International Schools, United Nations International Schools, International Baccalaureate Schools, and the Federation of British international schools, to develop students' intellectual knowledge, to enhance students' skill and internationalism, and to make them international-minded, independent, cooperative, and lifelong learners to live independently. For instance, IB officials train and monitor teachers every two years in these

educational contexts. Teachers are assisted by a handful of agencies, and Online Curriculum Center (OCC) specializes in recruiting international teachers. To enter the international schools, students must have specific documents of immigration or migration and should pose acceptable levels of English to benefit from CBI since they have started learning English as a medium of instruction when they are four. In addition to students' native languages and English, students are supposed to learn other foreign languages such as French, German, Spanish, and Arabic, depending on schools' preferences. International schools provide full English-medium education and make use of international curriculums such as *Oxford International Primary Science* (Hudson et al., 2014).

### 3.2. Data Collection and Analysis

Observation was employed to scrutinize scaffolding intentions to cast light on the research question in this study. Four teachers had been observed in their science classrooms three times for one month. They taught science to two classes of fourth-graders and two classes of fifth-graders, each with approximately 13 students in this international school. The data set was video recordings of teacher-student interactions during 12 online sessions. Observations were made between November and December of 2021. The platforms used in these classes were Adobe Connect and Skyroom, virtual classes in which everyone was provided with her webcams and microphones to communicate. A learning management system (LMS) was used to make documentation, report, and delivery information to students. Therefore, the video-recording of classes was available in LMS. To collect the data, the classes were video recorded and, soon afterward, transcribed, with detailed teacher-student interaction that discussed how scaffolding was provided.

This qualitative-based research aimed to determine the teachers' scaffolding intentions to improve the students' science learning in content-based instruction contexts. To analyze the data, this study followed a framework adapted from Van de Pol et al. (2010) (modified from Tharp & Gallimore, 1988; Wood et al., 1976). This framework was chosen because it proposed various scaffolding intentions, focusing on the purposes of scaffolding through conversation analysis (CA). CA provides in-depth analyses of classroom interaction with an emic view of students' learning and teachers' instruction (Macbeth, 2014; Melander & Sahlström, 2009). To do so, the researchers applied Van de Pol et al.'s (2010) framework to scrutinize scaffolding intentions, namely direction maintenance, cognitive structuring, recruitment, contingency management, and reduction of degrees of freedom. All the data from transcription were decoded and analyzed qualitatively using content analysis based on three various steps, namely, open coding, axial coding, and selective coding (Riazi, 2016). Double-coding was conducted on one-fourth of the data selected randomly to increase the reliability of coding,

and an agreement of 78% was reached. When there was disagreement with the well-informed CBI coordinator, i.e., inter-coder, an in-depth discussion took place and the coding was redefined.

## 4. Results

Data resulted in the discovery of five scaffolding intentions in the interaction between teachers and students suggested by Van de Pol et AL. (2010), including direction maintenance, cognitive structuring, recruitment, contingency management, and reduction of degrees of freedom. Below, the findings on each scaffolding intention, accompanied by relevant excerpts from classroom interaction, are presented.

### 4.1. Direction Maintenance

Direction maintenance kept students towards ultimate goals and engaged them on the task at hand. This scaffolding function, explicitly or implicitly, served to entail keeping the learning on target. It helped students stay focused and motivated to reach language and content knowledge goals. It was applied by active participation, doing experiments or tasks, modeling, using visual aids, and calling students' attention to the previous session or real-life experience. In excerpt 1, the science teacher tried to engage and keep students towards ultimate goals.

**Excerpt 1: Direction maintenance**

1 Teacher: Ok (.) I↑ type it↓. Very good Ava:, very good Helin:,(.) Saba, show↑ me again↓, I didn't: see yours. Very: good, Sophie. (0.8) Thank:: you so much;. All↑ right↓, let's turn to the next (.) page. Have↑ you checked questions1 (.) 2(.) and 3↓? OK: the first↑ question↓, Sophie, =

2 Student: =Ok (0.4) circle↑ three natural materials↓«, and underline↑

3 manmade Materials: ↓«.

3 Teacher: We have two: stones, so I cross one of [them: «. =

4 Student: = [Ok (.) Glass is not natural.

5 Teacher: What↑ should I do↓?

6 Student: I underline it. =

7 Teacher: = Underline (0.5) Pantea, what about plastic?

8 Student: Plastic↓ is not↑ natural«.

9 Teacher: So (.) when it is NOT natural (.)<it is<? =

10 Student: = Man made

11 Teacher: Lida- what↑ about↓ stone::? (3.0) what about stone:: (.)Lida ?=

12 Student: =Stone: is- natural;
13 Teacher: What about steel (.) Lida? =
14 Student: = Steel eh eh eh (0.4) I think:::: it's man made.
15 Teacher: Yes (.) it's man-made (4.0) OK (.) Ronika Izadi (0.3) whic↑h natural material: ↓ is often useful making POTS and bowls? =
16 Student: =I think:: it's -clay.

In excerpt 1, teacher 2 maintains direction by keeping students involved during activities and classroom discussions. She tries to keep the students motivated and focused on the learning task, revision, and investigation processes and, consequently, assesses their comprehension. Additionally, she assesses students' online comprehension through gained, sustained, and persevered tasks and questions. As can be seen in line 1, the science teacher models self-directed questions such as 'Have you checked questions 1, 2, and 3?' to re-direct the student back to the task. The teacher's use of questioning in the feedback move is also notable to create opportunities for affording students' involvement in the learning process (lines 5 and 7). In addition, tasks and activities would entail directing the students' attention to ultimate pedagogical goals.

### 4.2. Cognitive Structuring

Cognitive structuring, another intention of scaffolding, was aimed at organizing and justifying the students' thinking process. This scaffolding strategy was a means to instruct, model, and explain students' language and content knowledge. The selected excerpt given below (#2) is an instance of class interactions that can more vividly illustrate the teacher's instruction by doing experiments to orient students toward the topics.

**Excerpt 2: Cognitive structuring**

17 Teacher: So (.) everyone« (.) you see« different objects around us↑: « have different materials↑(.)yah? for example, something like paper(.) We have something made↑ of↓ metal: iron: wood: Yah, stone (.) clay:. So, they are↑ different↓(.)OK. let's listen: to Elisa. Materials:: like?
18 Student: My water bottle↑ is made of plastic=
19 Teacher: = ok, thank you« (4.0)
20 Teacher: Very; good (.) can you bend↑ every material around you?
21 Student: It's so: difficult to do it.
22 Teacher: look at this paper; ↑ (2.0) Look« at this paper: Selina, can you tell↑ me what I did?
23 Student: I want (to say that can I) [show you a shape of something that we can change the shape. =
24 Teacher: = [Yes: please«

25 Student: what↑ I want to say: ↓« one day: my dad bought clay and [I made] some shapes, I made these«. =
26 Teacher: = [aha, « aha«] clay(.) change the material:: Yes:. Youmna- any: questions? (3.0) Setiya (.) wait=
27 Student: =For example« ((inaudible))
28 Teacher: Oh::: it is made↑ of clay::? (3.0) or no it is teddy, ah ah (.) you: can bend it (.) yah? or twist, (4.0) twist means this (2.0) aha (.) aha (.)very good
(5.0) ok (.) Setiya then Elesa
29 Student: I can't: make (0.3) like the picture« ((inaudible)) I can't make:::
30 Teacher: which ONE? The pot? =
31 Student: =The pot in the page::
32 Teacher: from clay (2.0) can you:::? aha Great. and did you make anything: from clay before? have you ever made anything from CLAY? =
33 Student: =yes, I made a (2.0) little pot that [(I could put apple) in it
34 Teacher: [ aha] (4.0) nice.

At the outset of interactions, the teacher starts by facilitating a whole-class discussion to brainstorm the concept and provide examples. As some questions are addressed to the whole class, students delineate and mention their real-life experiences. The teacher extends her question based on the minimal answers and asks follow-up questions. She further asks some questions to check students' internalization of concepts and to make a more conducive atmosphere. The teacher expressed his intentions to allow students' independence through tasks or modeling. In general, this scaffolding intention could be used to reformulate, elaborate, link prior knowledge to the current topic or a broader context, or check students' comprehension of the scientific concepts. In this way, knowledge could be digested as part of the review process and transferred into the cognition process. In general, students organize new information and experience by providing schemas or explanations.

### 4.3. Reduction of Degrees of Freedom

Based on the results of class observation, science teachers intended to gradually reduce the degrees of freedom, support students' cognition, and convey the meaning through rephrasing, probing questions, providing examples, using explicit instruction and explanation, giving feedback, and modeling. Reduction degree of freedom was carried out when the students failed to do tasks and respond to the expected utterance. The following

excerpt is an example of a teacher's mediation to complete the tasks until the target response was produced.

**Excerpt 3: Reduction of Degrees of Freedom**

35 Teacher: The first one↑ is natural or: artificial? (natural or man-made)
36 Student: Natural«.
37 Teacher: Elena (.) what about glass? Glass: is natural ↑ or man-made↓?
38 Student: not natural:
39 Teacher: Sophie, where did you go? Thank you: everyone (.) I check (it). OK: now: I want you (.) to turn to page: (.) 50 - (8.0) Yes, this page. It said to match the material↑ with how: it uses↑, one: has been done for you: ↓, for example(.) look↑ at this one↓(.) this is clay: at first, it was clay then they made this pot↑ with it↓. So: they matched: ↑ it↓. You have to match. the natural↑ materials ↓and man-made↑ materials↓ (.) at first, for example, (This one is what) ↑ then. match it↓. Very: good. Saba, (0.4) Very: good, Elena. (8.0) Very good (.) Lida, Page 15↑ (.) Helin, =
40 Student: = (I'm on page 15, but what does) reeds mean?
41 Teacher: Reeds means« kinds of plants that we can make:: a hut for houses with them, the picture is exactly made reeds. Very: good, Pantea. (6.0) Lida, turn on↑ your microphone, =
42 Student: =OK«
43 Teacher: This↑ one↓, Lida, (.) Some rings: (.) bracelets: (.) these kinds↑ of things: ↓
I (match them) too? (0.3) Excellent,. Next one:. Ava=
44 Student: =We should match↑ it to wood↓.
45 Teacher: Next one (.) Pantea, (This is) a hut. The name↑ of this one is↓(.) hut.
46 Student: we:: should match hut to: reeds«. reeds?
47 Teacher: Reeds. ok: Helin, tell↑ me↓ these: are natural↑ materials↓ or (.) man-made
↑ materials↓?
48 Student: These are natural« ones.

The above excerpt is from the science class where the teachers and students go through the tasks. As indicated in excerpt 3, the science teacher provides limited options, gives an example, or makes a comparison when

students cannot respond correctly to a question or do tasks independently. The teacher tries to limit the scope of concepts by posing constant questions and revealing more of the target words until students produce the expected response. The teacher tries to mark the critical features by raising questions and providing contingent scaffolding strategies upon the students' answers. In addition, providing clear examples shows convincingly how the teacher engages students in lessons to make concepts more understandable and straightforward. In line 39, the teacher affords students' involvement with good examples suited to the needs of the students. In addition, visual clues are contingently employed to embed concepts or tasks in a rich context and to contextualize scientific concepts. The teacher tries to orient students by offering an explicit explanation to limit the scope of concepts.

### 4.4. Recruitment

Another scaffolding intention was recruitment, which got a student involved, enthusiastic, and interested in the learning experience. In these situations, the teachers helped students adhere to the requirements of the tasks by drawing their attention to lessons. This scaffolding intention was mostly aimed at the students' engagement, participation, and, eventually, learning. The excerpt below is the sample of enriching instruction and constructing meaning through applying recruitment.

**Excerpt 4: Recruitment**

| | |
|---|---|
| 49 Teacher: | Ok, everyone: (.) At↑ first: ↓ we are going to see«. we are going to watch↑ some videos about dissolving, OK, then: we are going to do: them ourselves« OK, at HOME↓ let's: ↑ watch↓. (Video was playing) |
| 50 Teacher: | Ok everyone, you watched↑ the video↓ (.) NOW:, let's start and do:↑ the experiment (.) yourself↓. OK? let's↑ do: it yourself↓. Now (.) everyone, you have(.)(aaa) hot (0.5) hot tea (1.3). water or a cup of↑ hot tea↓, and please bring another: glass of cold↑ water↓«. OK? (0.4) One hot (.) one cold (8.0) then:, (.) please↑ bring↓ then I will tell you. Then«, I want to divide you into two↑ groups↓ to do experiments. Please (.) ask↑ each other the questions: related to pages (.)74 and 75 then« I will ask you. Only↑ these: two: pages. |
| 51 Student: | Miss, |
| 52 Teacher: | OK (.) wait Armita. |
| 53 Student: | ((inaudible)) |

| | |
|---|---|
| 54 Teacher: | OK (.) Armita, add one spoon:: of sugar in BOTH« ok? one spoon in cold water::: and one: spoon of sugar in hot water:: (.) OK? then mix↑ them ↓(.)ok, everybody (.) let's do:: and please then type for me:: ok (.)after doing- OK (2.0) that in which↑ water::↓(0.3) in which water; (.) the sugar's dissolved earlier, -fast-quickly: earlier and more quickly than the other -more quickly than the other« let's (write it) (4.0) Yeah the sugar:: should be disappeared-good Armita (2.0) good (4.0) but it can be slower than but↑ no problem↓ (4.0) Vania (.) did you do:: it? (5.0) did you pour sugar:: in hot↑ and cold water::↓ (2.0) pardon (5.0) you can put it in tea:: (.) no problem (2.0)if you have tea- hot tea you can use:: in hot tea:: |
| 55 Student: | excuse me teacher ((inaudible)) |
| 56 Teacher: | Arnica (.) can you talk louder:::? and (.) come near: to your microphone? |
| 57 Student: | Should we mix them? |
| 58 Teacher: | yeah (.) yeah (.)you should mix them: -BOTH of them:. |

As excerpt 4 reveals, the teacher gains and maintains the students' interest in the task to facilitate learning and avoid distraction. There are several strategies in which the teachers enlisted the students' interest in the task, such as challenging activities, pair and group work, visual aids, examples from the real world as a basis for discussion, praise, and fun activities. In online classes, teachers tried to encourage students to participate more attentively in the learning process by doing an experiment and watching the relevant videos which contextualized the science concept and constructed meaning. In addition, whenever students were handed over the responsibilities or worked in pairs or groups, they were more involved and less anxious. Furthermore, teachers' discursive aids like rising intonation, pausing, or verbal praise attracted the students' attention to the required activities.

### 4.5. Contingency Management/ Frustration Control

This analysis showed that contingency management or frustration control provided calibrated, dependent, and provided support to facilitate student performance despite inhibiting or diminishing frustration. The last scaffolding intention, frustration control, acted contingently to students' reciprocity, incorrect answers, or silence. In addition, some technical terms or abstract concepts needed the provision of explanations, instruction, and contextualization to reduce their frustration, as demonstrated in excerpt 5.

**Excerpt 5: Contingency management/Frustration Control**

59 Teacher: We are completing page 35 of our book. Your friends are drawing a room: and the light. Very: good Lida, (9.0) Excellent Pantea, What↑ about you↑ Elena? (9.0) OK(.) we want to answer the next question↑ together↓. (7.0) Saba, read↑ the next question: ↓. =

60 Student: =Ok. Are switches (hehehe) switches circuit breaks?

61 Teacher Are switches: circuit breakers:? What is the meaning of [breakers↑?

62 Student: No (.) [I think it means gap. =

63 Teacher: = Aha, it means (.) it makes↑ gap ↓and then: fixes↑ it↓(.) Does↑ it do: the same thing:?

64 Student: What?

65 Teacher: Circuit breakers means something that we can turn: it off«↑ and turn it on↑«. Now, tell me (.) are switches circuit breakers↑ or not↓?

66 Student: I think (.) yes.

67 Teacher: Yes (.) exactly:: because we (eh eh switch) you can make gap and then you can fill the gap: so they are real circuit breakers:. (3.0) question number 2 (.) Lida (.) read it.

68 Student: why are two↑ or more batteries: ↓ sometimes needed?

69 Teacher: ok (.) Sophie: turn on your webcam(.) we are::on page 35. Lida, can you answer? =

70 Student: =Some objects↑ need big batteries::↓ and some: objects need small – batteries.

71 Teacher: So: why sometimes we need two:: batteries or -one battery?

72 Student: for example (.) the electricity (goes it out) (.)we should put- we should put:: another one in side it.

73 Teacher: Yes:: very nice (.) Elena

In line 60, while the task is carried out, one of the students gets frustrated in a demanding situation. In view of the student's frustration, the teacher clarified the concept through simplification and bridging to the

previous session, which is contingently adjusted assistance. In addition, this scaffolding intention can be enacted through explicit links to real-life or personal experiences to diminish the frustration of both students' language and content knowledge. When the students face ambiguous learning points, the teacher tries to use visual aids to deepen and shorten the scaffolding process. The teacher provides contingent support in view of the individual students' level when the expected answers are not given. This scaffolding intention is tricky because a teacher has to provide ZPD-oriented contingent support to all students.

## 5. Discussion

The teachers' scaffolding intentions, including direction maintenance, cognitive structuring, recruitment, contingency management, and reduction of degrees of freedom, were scrutinized in online English-medium content instruction. The findings revealed that the cognitive load of learning concepts was not the only determiner of teachers' scaffolding; nevertheless, sometimes, variety among activities to recruit interest gained mounting attention from teachers to provide scaffolding. In addition, this study illustrated that particular scaffolding intention might be provided through numerous activities or verbal cues in terms of students' needs, contextual characteristics, and cognitive complexity of subject knowledge. The results of this study demonstrate that students' needs, teachers' preferences and pedagogical skills, the characteristics of content knowledge, educational contexts, cognitive complexity of subject knowledge, and the purpose of the subject led to considerable variations in teachers' intentions of employed scaffolding.

As one of the striking scaffolding intention, cognitive structuring was enacted via providing schemas, verbal and visual cues and hints, samples, modeling, and explanations concur with previous studies (Cunningham & Lachapelle, 2016; Li & Zhang, 2020; Nguyen & Williams, 2019). The findings signified that cognitive structuring could be applied through reformulating the scientific concepts, linking prior knowledge to the current topic or a broader context, or recapping learning the scientific concepts to rekindle or bring back knowledge. In addition, the process of knowledge development, organization, and understanding of the concepts would be applied during the warm-up time, in the middle of instruction, or as a post-task. However, these studies emphasize the provided scaffolding strategies, which could be applied for numerous instructional purposes. As noted in Van de pole et al.'s framework (2010), this scaffolding intention would support evaluating and recapping students' internalization and comprehension of concepts and cognitive processing. Furthermore, the findings are in agreement with the study by Tajeddin et al. (2020) where they referred to assist students in reviewing the concepts that contribute to a better

understanding. More generally, these findings are consistent with the role of the cognitive supporting process and its effects on organizing and justifying students' cognitive structures (Baxter & Williams, 2010; Cunningham & Lachapelle, 2016; Nguyen & Williams, 2019). The finding would imply that due to the duality purpose of CBI on both language and content knowledge, cognitive structuring was frequently provided to evaluate and recap students' internalization and comprehension.

Teachers' contingent and moment-by-moment mediation were employed to facilitate learning in a dynamic process. As to the value of contingency in scaffolding notion, our findings indicated that the teachers provide tailored and adjusted support to inhibit or diminish frustration through explanations, visualization, instruction, and contextualization. Therefore, the teachers mostly adopted more interactive or contingent tutoring styles in a less demanding situation. Teachers tailor the support to provide a contingent learning environment if the students are silent or have difficulty with the response (Belland, 2014; van de Pol et al., 2010). Our findings are consistent with Heron and Webster (2018), Li and Zhang (2020), and Nguyen and Williams (2019), wherein current students' performance characteristics indicate the types, techniques, and strategies of provided scaffolding. Moreover, the current study's findings are partially in line with Tajeddin et al.'s (2020) study, which underlined controlling frustration through questioning, clarification, hint, rephrasing explanations, and visual aids. Although widely accepted, it suffers from some limitations due to virtual classes to signify individual students' levels and needs. An important question associated with online classes is students' participation and mutual interaction. It is unclear whether virtual classes are influential on the active participation of students and probing their actual ZPD and then generating support appropriate to their needs (Van de Pol et al., 2010).

The findings divulged that science teachers primarily support students' cognition, transfer the knowledge, and develop the activities by simplifying matters into manageable parts and providing visual clues or verbal tips. The data provided evidence that the science teachers in online classes predominantly provided visual clues besides verbal clues to reduce the degree of freedom. Additionally, the findings related to this part of the study revealed that teachers gradually aimed to reduce the degrees of freedom by posing constant questions, making a comparison, and providing real-life questions and samples. This implies that constant and gradual reduction is associated with students' failure to learn or do tasks. Overall, these findings are in accordance with those reported on teachers' providing support to eliminate the numerous alternatives and limit the options to reach the task's endpoint (Buenner, 2013; Heron & Webster, 2018; Tajeddin et al., 2020). The finding here suffers from the same limitations associated with the

difficulty of pinning down students' ZPDs on content or language knowledge in line with studies by Awan and Sipra (2018), Stoller and Fitzsimmons-Doolan (2017), and Tajeddin et al. (2020). We speculate that a reduction degree of freedom is primarily due to the lack of language knowledge, as paraphrasing and visual aids could contextualize scientific concepts and facilitate students' comprehension.

Regarding recruiting interest, the findings revealed the teachers' desire to apply various tasks and activities whose main goals are students' engagement, participation, and, eventually, learning. Additionally, the findings unraveled that teachers' managerial decision-making, including making modeling, pair/group working, playing games doing projects, and doing experiments, would recruit students' interest. Besides teachers' managerial decision making, tempting materials and teachers' manner would assist teachers in getting students interested in the learning process and help them adhere to the task's requirements. The finding would imply that due to students' age, teachers tried to involve them and avoid distractions in the teaching process. Similar to this finding, Buenner (2013), Kang (2015), Li and Zhang (2020), and Tajeddin et al. (2020) argued that teachers would encourage and entertain students to follow up on their learning. Also, students' empathic talking about their personal lives and providing real-life samples would engage learners in learning (Heron & Webster, 2018; Walsh et al., 2011). Our findings on teachers' enactment of recruiting interest are in line with Ko and Wang's (2008) study in that it was occasionally enacted, whereas Tajeddin et al. (2020) found it as one of the most influential scaffolding intentions in the learning process. This may be due to de the nature of virtual classes in limiting teachers' creativity and activities. However, what seems significant in recruitment the interest is the types of activities of institutionally prescribed materials for the students (Vinita & Ilankumaran, 2020).

Finally, direction maintenance, mostly related to metacognitive activities, was the least enacted scaffolding intention. The findings indicated that maintaining the direction was enacted to check students' comprehension, make them focused and motivated to reach goals of both language and content knowledge and transfer responsibilities. The results indicated that the science teachers focused on students' active participation, such as doing experiments or tasks and modeling to call students' attention to the applicability of science matters in real-life or personal experiences. As it is clear from the findings, the science teachers tried to direct students toward the pedagogical aims and engage them on the tasks at hand, while it should be noted that developing self-supporting and self-reflecting strategies were

demanding for the teachers. Furthermore, teachers' scaffolding should support pupils in developing self-supporting strategies for maintaining direction to prevent over-dependence on teacher support. Similar to our findings, some studies uncovered that the pursuit of a particular objective is not just in the alignment of pedagogical purposes but dependent on students' and teachers' characteristics, students' proficiency level, and the nature of content knowledge (Heron & Webster, 2018; Li & Zhang, 2020; Tajeddin et al., 2020). Moreover, it was also revealed that despite the students' age, as they were between 10 and 12, and the highly challenging nature of reflection, the teachers of the present study attempted to make students reflect on their activities and, in turn, hand over the responsibility. This is in alignment with a few other studies (e.g., Nguyen & Williams, 2019; Tajeddin et al., 2020).

## 6. Conclusion and Implications

The current study was conducted through classroom observation to afford insights into the teachers' scaffolding intentions in science CBI. Analyzing teachers' scaffolding techniques and strategies evidenced the prominent role of scaffolding intentions in teachers' instructions to promote students' cognitive learning, motivation, and classroom participation through concept-based, project-based, and inquiry-oriented teaching approaches. The findings indicate that scaffolding intentions are not only dependent on teachers' pedagogical skills, but are sometimes enacted and verified by materials characterization, the nature of the content subjects, the cognitive load of learning both content and language knowledge, and contextual characteristics. The wide range of different activities, such as doing experiments, projects, or tasks, modeling, using visual aids, having lectures, and whole-class guided discussions, indicates that in addition to cognitive structuring, teachers recruit the interest and mutual engagement among all participants in the interaction. Besides, teachers' scaffolding enhances interactive classroom interaction processes to ensure that whether students are oriented towards ultimate goals and applicability of this concept in real-life experiences. Moreover, it was uncovered that science teachers enacted various scaffolding strategies to extend the students' ZPD to higher levels and engage students in the learning process. Science teachers constantly attempt to use differentiated contingent support tailored to students' reciprocities and feedback at any given time and withdraw it at the right time. Teachers can subsequently reduce degrees of freedom by providing examples, visual cues, and clues, modeling, explaining, and posing questions to simplify the concepts and activities by doing what the students cannot do themselves.

The results obtained from scaffolding intentions to promote students' learning have pedagogical implications. This study unveiled important

practical information for CBI teachers, teacher educators, and researchers by making them aware of the significance of scaffolding in the teaching process. Science teachers who strive for professional development would apprehend scaffolding enacted by teachers in science CBI. In addition, this study shed light on the employment of various scaffolding intentions and, subsequently, scaffolding strategies and techniques. Additionally, the findings would offer an opportunity for teacher educators to devise and run some teacher education courses and workshops to heighten pre-service and in-service teachers' knowledge of scaffolding intentions and techniques. Furthermore, as was highlighted in this study, teacher-student interactional patterns would foster teachers' awareness of constructive teacher talk and pedagogic goals.

This study has a few limitations. The data were elicited from experienced female teachers of an international school in Tehran. Given this, it is suggested that future research be conducted on teachers with various age, teaching experience, and gender. In addition, different results may emerge if other studies involve different subjects of content-based instruction. Also, more studies are needed to provide evidence of the effect of scaffolding on students' learning. Also, a better view of teachers' scaffolding will be gained if field notes, stimulated recall, or interviews could be used to enrich data. Finally, studies can investigate various scaffolding strategies in fulfilling each scaffolding intention.

## Acknowledgments

The authors express their gratitude to all administrators, teachers, teacher instructors, and TPP designers who played a significant role in this study and contributed to accomplishing the purpose of the study.

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## Appendix

### Transcription Conventions (Jenks, 2011)

[[ ]] Simultaneous utterances – (beginning [[) and (end]])
[ ] Overlapping utterances – (beginning [) and (end])
= Contiguous utterances (or continuation of the same turn)
(0.4) Represent the tenths of a second between utterances
(.) Represents a micro-pause (1 tenth of a second or less)
: Elongation (more colons demonstrate longer stretches of sound)
. Fall in pitch at the end of an utterance
, Slight rise in pitch at the end of an utterance
- An abrupt stop in articulation
? Rising in pitch at utterance end (not necessarily a question)
CAPTIAL Loud/forte speech
__ Underline letters/words indicate accentuation
↑ ↓ Marked upstep/downstep in intonation
° ° Surrounds talk that is quieter
Hhh Exhalations
.hhh Inhalations
he or ha Laugh particle
(hhh) Laughter within a word (can also represent audible aspirations)
> > Surrounds talk that is spoken faster
< < Surrounds talk that is spoken slower
(( )) Analyst notes
( ) Approximations of what is heard
$ $ Surrounds 'smile' voice
*per syllable Unintelligible syllable