Scaffolding in conceptual science

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Abstract Scaffolding is a technique developed to improve learning activity. The technique was designed to help students noticing their goals and to provide support for the students’ needs. It is important to realize that each student has their own development tempo or Zone Proximal Development (ZPD). Therefore, every teacher is required to be able to provide teaching in accordance with each student’s ZPD. This individual difference will affect student’s method of learning and its result. In this case, this study employed a descriptive-qualitative method in order to describe the implementation of scaffolding in Situation-Based Learning (SBL). The respondents of this study were the fifth-grade elementary school students (10-12 years old) who studied the concept of Force. It was found that scaffolding technique that was optimally provided by teacher could improve students learning activity in understanding the concept. To conclude, it was revealed that learning activity using scaffolding could improve students’ learning result.

1. Introduction

Students cannot be left unguided during classroom learning. They need direction and guidance from teacher. The primary duty of a teacher is not only teaching students about the learning material, but also to give an insight to students that learning is necessity. Therefore, it is not about to provide informative concept, but it is more on how teachers plan their classroom activities to create a meaningful learning process for students.

In this case, scaffolding is a technique to improve learning activity to be more meaningful. This technique was designed to help students realizing their goals and to provide support for them, especially those who require help in learning [1]. Scaffolding is aimed at helping students in completing their assignments and guiding them to be on the right and oriented track [2]. Teachers have to understand that the learning materials in which students have to learn cannot be comprehended immediately. Using scaffolding, however, which still requires development, will enable students to achieve their development goal.

By giving this technique, teachers can help students to be successful. It is important to be noted that teacher’s encouragement is really necessary to optimize students’ achievement. Scaffolding is aimed at providing the right direction and helping them to reduce their puzzlement. Considering that each student has their own development tempo or Zone Proximal Development (ZPD), hence, teacher is required to be able to provide teaching in accordance with each student’s ZPD. This individual difference will affect student’s method of learning and the result (Figure 1).
Teachers are required to anticipate students who are confused by developing a step-by-step guide, explaining what should be done, helping them to understand why, and convincing them the importance of the learning activity [4]. Therefore, if the students understand the instruction, they will realize why they are learning, which will encourage them to develop their knowledge.

The goals of scaffolding implementation in a learning activity are related to the development of students’ self-concept. Scaffolding is aimed at encouraging support development, stimulating students’ creativity, improving students learning, helping students’ self-concept development, providing guidance and direction, inciting students reflect, and helping and aligning learning goals [5]. These goals infer that scaffolding implementation has several advantages in improving students’ creativity, fostering students’ sense of responsibility, and developing students’ higher-order thinking.

1.1. Research questions
How is the implementation of scaffolding in a Situation-Based Learning (SBL) in the learning process of Force concept?

1.2. Variety of techniques in scaffolding
There are several scaffolding techniques that can be implemented in a learning activity according to Rochler & Cantlon [6].

1.2.1. Modeling of desired behaviors. There are three methods in modeling behaviors, including: 1) modeling hard thinking behavior, verbalism of thinking process to solve certain problem; 2) modeling hard speaking behavior, demonstrating assignment completion with a verbalism of thinking process or problem-solving strategy to draw a conclusion; and 3) modelling performance behavior by demonstrating a simple task that was completed without verbal explanation.

1.2.2. Offering explanation. Teachers observe students’ understanding and provide feedback on their performance. If the students have a solid understanding, the feedback should be a clue or keyword to make students remember important information.

1.2.3. Inviting student participation. Teachers have to be creative in inviting students’ active participation in order for them to obtain experience.

1.2.4. Inviting students to contribute clues. Teachers can apply this method by guiding and inviting students’ response to the currently discussed learning material or concept using questions.
1.2.5. Verifying and clarifying student understanding. After students acquiring new experience and knowledge, verification and clarification steps are taken. Teachers are required to assess students’ understanding of continuously and provide feedback.

1.3. Situation-Based Learning (SBL)
SBL learning consists of four steps: 1) creating the situation; 2) problem posing; 3) problem solving; dan 4) applying the concept, as illustrated in the following figure 2 [7-13].

![Situation-Based Learning Diagram](image)

**Figure 2.** Situation-Based Learning.

2. Method
This study employed descriptive-qualitative method to describe the implementation of the scaffolding technique in each step of SBL learning in learning Force concept. The following are the scaffolding techniques implemented in the learning activities: 1) Modeling of the desired behavior; 2) Offering explanation; 3) Inviting students’ participation; 4) Inviting students to contribute clues; and 5) Verifying and clarifying student understandings. The respondents of the study were 10 to 12 years old fifth grade students of a public elementary school in Sumedang, West Java.

3. Results and discussion
The following is the illustration of the implementation of the scaffolding techniques in SBL learning regarding Force. It was started by presenting the situation to the fifth-grade students.

![Situation in magnetic force learning material](image)

**Figure 3.** Situation in magnetic force learning material.
During this step, teacher guided students to be able to model performance through a simple demonstration about a magnetic force so that teachers were not required to give an excessive verbal explanation (Figure 3).

Students were instructed to observe the picture of the magnetic force on an object. Then, as a group, students were asked to gather the information that they could find during the problem-posing step (Figure 4).

A. Write down any interesting information you can find from the picture!
1. .............................................................
2. .............................................................
3. .............................................................
4. .............................................................
5. .............................................................

B. Change the interesting information above into a question form!
1. .............................................................
2. .............................................................
3. .............................................................
4. .............................................................
5. .............................................................

Figure 4. Problem posing worksheet.

The main problem that was encountered during the problem-posing step was that the students were still confused about how to present the information. The reason was that they were not used to find the learning concept on their own.

The teacher also provided a scaffolding technique support by giving an explanation around the classroom periodically to each group. However, there are four things to be noticed by a teacher [14]: 1) clear articulation when explaining goal; 2) the instruction given by the teacher; 3) thorough observation toward students’ work result; and 4) providing effective class organization and method.

It was found that when the teacher went around the class to check on a group, when other groups should discuss on their own first, sometimes, they immediately called for the teacher to ask a question clarifying something that they did not understand yet. In this situation, other than initiative check on each group, the teacher is also required to provide support for the group in need. Moreover, when observing a group, the teacher should not immediately provide support and let them ask for it first. This is also an implementation of the third scaffolding technique, which is inviting students to contribute clues.

Student : “Miss, what does it mean by write the information?”
Teacher : “Let’s see, what is that picture?” [assessing students’ knowledge]”
Student : “A picture of a magnet, Miss. A magnet that can attract needles and pins.”
Teacher : “Does the magnet can attract a leaf and a pencil?”
Student : “No.”
Teacher : “Why a magnet cannot attract a leaf and a pencil?”
Student : “Because they were not made of iron, Miss.” So, they cannot be attracted to.”

From the dialog above, it can be observed that students could apply their knowledge about magnetic force based on the given situation. This was also an application of one of the techniques, which is inviting students to contribute clues during the discussion.
Teachers are required to assess students’ understanding of continuously and provide feedback (Figure 5). Its students’ understanding is reasonable, the teacher can verify it. However, if the understanding is still lacking, the teacher has to give clarification [15].

The following is the formulation of the problem given by Group 4 (Figure 6 and 7):

From the question that was agreed upon to be completed, students were moved to the problem-solving step.

The intended experiment is as follows (Figure 8):
From the problem-solving activity, using the support of the scaffolding technique, students are expected to be able to find Force concept. They also understand that other scientific concepts such as Force are not only written in a book, but it also exists around us. Therefore, students can understand that learning is a necessity, especially learning about something around them.

4. Conclusion
There are five scaffolding techniques implemented by the teacher to optimize students’ learning process, which are: 1) students model desired behavior; 2) teacher offers an explanation; 3) teacher invites student participation; 4) teacher invites students to contribute clue; and 5) teacher verifies and clarifies student understanding. Learning process with scaffolding techniques in SBL learning activity was found to be able to improve elementary students’ learning result in understanding the concept of Force.

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