The Effectiveness of Scaffolding in Web-Based Learning Systems

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Introduction

Today’s classrooms have more access to the Internet than ever before and teachers are able to educate their students through web-based instruction. However, teachers are now faced with the pedagogical challenge to create web-based learning systems (WBLS) that meet the educational needs of their students in an online environment. The entire design and development of the web-based learning system needs to support the lesson’s goals and the students’ learning process. Is scaffolding an effective way to support students in an online environment?

When designing a WBLS it is important for educators to create effective and meaningful learning experiences for their students. When thinking about what features are necessary to include while designing a web-based learning system many people may think about the importance of social presence for the teacher and student, providing time for student reflection, administering quality assessments, and creating a classroom community. Although these are very important aspects of web-based learning systems my main question lies among what support is being given to the students during their learning process, when concepts are first being introduced, to support their individual needs and to promote their learning? Are students just being sent to read various articles and watch video clips without any guidance or, have tools been put in place and have activities been structured to provide appropriate levels of scaffolding to support the learners’ experiences?

I know how important modeling, coaching, and scaffolding are to support learners in a typical classroom setting and I would like to find out what research has to say about scaffolding in a web-based classroom setting. Are cues, reminders, examples, and guidance important for teachers to think about while designing web-based instructions? The purpose of studying this
topic is to educate myself about how to support students’ learning process through web-based instruction which will assist me in designing and developing a Life Science WBLS for my fifth grade students. I also hope that the findings I report through my literature reviews will help others incorporate appropriate instructional strategies and methods while designing web-based instruction.

As a teacher, I partake in instructional scaffolding to help my students master concepts and skills by providing them support at the beginning of a task and then allowing them to progress on their own. While thinking about the most important features needed to provide web-based instructions I wonder what research says about the importance of scaffolding in web-based learning systems? What does scaffolding provide for students in an online environment? What delivery methods work best for scaffolding in an online learning environment? With these questions in mind I would like to explore the effectiveness of scaffolding in web-based learning systems to help me in designing and developing my own WBLS for elementary students.

**Literature Review**

“In traditional instruction, students look to the teacher for what to learn, how to learn it, and whether sufficient learning has taken place” (MacGregor & Lou, 2004, p.163). Students learn by listening to lectures, reading textbooks, participating in activities, and completing assignments. However, web-based learning systems are more learner centered in which students need to self regulate their learning. In the research article entitled, “Web-Based Learning: How Task Scaffolding and Web Site Design Support Knowledge Acquisition,” MacGregor and Lou (2004) discuss how web-based learning systems have “great potential to improve the development of higher-order cognitive skills, critical thinking, and problem solving skills that the
fast paced information age demands; however, in order for it to work, students need support and scaffolding” (p. 164).

The concept of scaffolding comes from Vygotsky’s social constructivist view of learning in which assistance is provided by a more competent adult or peer (Chang, Tarng, & Shin, 2010). Four different types of scaffolds were provided by MacGregor and Lou (2004) that they found to be helpful in an online learning environment. The four different types were conceptual, metacognitive, procedural, and strategic scaffolds (MacGregor & Lou, 2004). Conceptual scaffolds include outlines and concept maps that will assist the learner in identifying the important aspects of the lesson. Metacognitive scaffolds may be a simple reminder for a student to reflect on the lesson’s goal or on what they have learned to encourage them to recall specific details. Procedural scaffolds may include detailed directions, rubrics, navigation maps, charts, graphs, or graphics that assist the learner in gaining knowledge in a way that lightens their cognitive load. And lastly strategic scaffolds can be used to provide alternative approaches and different ways to solve problems or understand a concept.

MacGregor and Lou (2004) conducted a scaffolding project in which they gave two separate groups of fourth grade students a WebQuest with different means of support. One group received the goal of the WebQuest and expectations for the final project and the other group was provided with an explicit set of directions that identified what information should be collected and how to organize it for the final project. By analyzing the results, it was determined that when students were provided an explicit set of procedures and organizational pieces, these aspects helped facilitate the web-based learning activities and the acquisition of knowledge (MacGregor & Lou, 2004). However, even though these procedures helped the students navigate
the site and collect information, the results showed no sufficient evidence that the explicit set of
directions maximized the knowledge students gained from the experience.

MacGregor and Lou (2004) also conducted another scaffolding project to determine
whether or not providing students with a concept mapping scaffold to help them organize their
newly acquired knowledge in a web-based learning system would influence their learning. A
comparison was made between a group of students that interacted in web-based learning with
scaffolding and a group in which scaffolds were not provided. The results of this study revealed
that “conceptual scaffolds in the form of a study guide and a concept mapping template
supported students as they were engaged in learner-centered resource-based learning”
(MacGregor & Lou, 2004, p.172). Providing a study guide helped students know what
information was important for them to extract and absorb. The concept map helped students
organize and synthesize the provided information while facilitating higher ordered learning.
These conceptual scaffolds helped students gather information about the lesson’s learning goals.

Oboko and Njenga (2011) also discussed the importance of concept map scaffolds in
their article entitled “Use of Concept Map Scaffolds to Promote Adaptive E-Learning in Web-
Based System.” Oboko and Njenga conducted an experiment in which their learners were
divided into an experimental group (with the concept map scaffold) and a control group (without
the concept map scaffolds) to see if the concept map scaffolds in an adaptive learning
environment would help the students learn. The findings showed that the experimental group
(with the concept map scaffolds) scored significantly higher than those of the control group.
From this experiment, the researchers concluded that the concept map scaffolds can be used to
support students’ learning in an adaptive e-learning environment (Oboko & Njenga, 2011). The
use of prior knowledge is important for students to recall, helping them set a foundation to build
their new knowledge onto. Concept maps help students become aware of what they know and help them modify their prior knowledge (Oboko & Njenga, 2011). Oboko and Njenga (2011) discussed how concept map scaffolds allow learners to reach the lessons objectives through step-by-step guidance and support.

Chang, Tarng, and Shin (2010) investigated the effectiveness of scaffolding for elementary students in a web-based learning system in which the students had varying levels of learning achievement. They conducted a quasi-experiment in which students were separated into three different groups: “control group (without scaffolds), experimental group A (scaffolds providing by on-line conversation) and experimental group B (scaffolds providing by face-to-face conversation)” (Chang et al., 2010, p.459). The results of their experiment showed substantial evidence of student learning (for both high and low achieving students) after the students interacted with the web-based learning system. However, the scaffolds provided through face-to-face conversations enhanced the learning of the higher achieving students more than it did through web-based instructions. Despite these findings, the low achievement students showed no significant differences with or without the scaffolds in the web-based learning system. The findings show that the web-based learning environment motivated all the students to learn and Chang et al. (2010) also concluded that the scaffolds provided by the web-based learning system helped the students become more responsible and independent learners.

In the article entitled “Usability Assessment of a Web-Based Learning System for Teaching Web Development: A Progressive Scaffolding Approach,” the authors Hall, Digennaro, Ward, Havens, and Ricca (2003) focus on the underling fact that too often not enough time and effort are put into the design process of developing web-based learning systems. They stress the importance of active learning in web-based learning systems and
discuss how many systems are just used to display information. Hall et al. (2003) explains how “research in hypermedia learning systems indicates that it is very important to provide the learner with some level of guidance, and this too, is often lacking in these web-based systems” (p. 2). Their article describes a progressive scaffolding approach for the design of a web-based learning system. Hall et al. (2003) created a web-based learning system that provided progressive scaffolding in the form of text, graphics, and narrated videos that was used to conduct a scaffolding experiment. For this experiment, seven college students from the University of Missouri were evaluated while using the designed web-based learning system to find out “to what extent do users utilize the different scaffolding options (text, graphics, and video)” and “how does their use of the various options relate to performance” (Hall et al., 2003, p. 3). Their activity on their computer screen was being captured and their facial expressions were video tapped throughout the experiment to collect data. The data reviled that the students primarily used the text and video scaffolds while the graphics were not used by many of the participants. Hall et al. believes that the students did not use the graphics because they “relied almost totally on the most and least minimal scaffold (i.e., text and video) and ignored the other” (2003, p. 8). In regards to performance, when the time spent viewing the text increased so did their performance, however, the opposite was true for the video. Their best explanation was that the text was all that most of the participants needed and only some participants needed the video support. The overall results of this experiment supports that providing students with a progressive set of scaffolding options is a viable way to enhance the learning process (Hall et al., 2003).

Overall, researchers seem to agree that scaffolding in traditional face-to-face classrooms and through web-based learning systems are important for students to progress and achieve
success. In the article “Scaffolding for Success,” Jamie Mckenzie (1999) explains eight characteristic of educational scaffolding. The eight characteristics are:

1. Scaffolding provides clear directions
2. Scaffolding clarifies a purpose
3. Scaffolding keeps students on task
4. Scaffolding offers assessment to clarify expectations
5. Scaffolding points students to worthy sources
6. Scaffolding reduces uncertainty, surprise and disappointment
7. Scaffolding delivers efficiency
8. Scaffolding creates momentum

These eight characteristics prove why scaffolding in a web-based learning system is important and why it is a necessary part of web-based instruction. Scaffolding helps guide students to learn concepts on their own by providing them support and clarification as needed.

Results/Findings

While analyzing the results I came across while conducting my literature review in regards to the effectiveness of scaffolding in web-based learning systems, the researchers’ findings confirmed most of my preconceived beliefs. I strongly felt that scaffolding techniques and strategies were important factors to include while designing a web-based learning system (especially for elementary students) and the literature I reviewed supported these ideas. The research suggests that appropriate levels of scaffolding are important to incorporate in web-based learning systems to promote and encourage active learning.
What does research say about the importance of scaffolding in web-based learning systems?

MacGregor and Lou’s (2004) research definitely supports the importance of providing scaffolds in web-based learning systems. MacGregor and Lou (2004) explain that although many students are savvy enough to surf the Internet on their own, they do need support and guidance to gather and identify important facts from the provided information. Web-based learning systems are definitely learner centered and in order for students to be able to achieve their learning goals they need support in the form of various scaffolds to help them engage in and interpret the material provided.

Research presents that scaffolds within web-based learning systems should be provided for different levels of student’s zone of proximal development. This is helpful because then the students can choose which scaffolds they need to support their learning needs. Most researchers agree that WBLS scaffolds do not necessarily maximize the knowledge gained by the students but instead the scaffolds help facilitate the WBLS’s activities and the acquisition of knowledge.

What does scaffolding provide for students in an online environment?

Data collected from various web-based learning system experiments have concluded that scaffolds provide learners with guidance in recalling prior knowledge, collecting and organizing data, reflecting on the lesson’s goals, and assistance in completing the activities provided by the WBLS. Within web-based learning systems, scaffolding provides clear directions, clarifies a purpose, keeps students on task, offers assessment to clarify expectations, points students to worthy sources, reduces uncertainty, delivers efficiency and creates momentum (Mckenzie, 1999). All these factors greatly impact the success that students have with web-based learning systems.
What delivery methods work best for scaffolding in an online learning environment?

Four different types of scaffolds were provided by MacGregor and Lou (2004) that were found to be helpful in an online learning environment through experimental data. The four different types of scaffolds were conceptual, metacognitive, procedural, and strategic scaffolds (MacGregor & Lou, 2004). Conceptual scaffolds help students identify the key aspects of a lesson through outlines, concept maps, advanced organizers, objectives, and study questions. Metacognitive scaffolds are activities that prompt students to reflect on prior knowledge and the lesson’s goals to make connections. When explicit directions, rubrics, navigational maps, guided tours, overview diagrams, table of contents, charts, graphs, and pictures are presented to help the learner these are called procedural scaffolds. Lastly, suggestions provided for alternative thinking are called strategic scaffolds. While designing a WBLS a combination of these scaffolds that best fits the needs of the lesson and the learners are what the designer should included to support progression throughout the site.

Is scaffolding an effective way to support students in an online environment?

Researchers agree that learners need some level of guidance while learning through a web-based learning system. Educators cannot assume that all learners know how to navigate a WBLS or that they know how to identify the main ideas of an entire WBLS. Scaffolds are definitely an effective way to support students in an online environment. Scaffolds can help motivate students to learn, provide them with step-by-step guidance, and make them become more confident, responsible, and independent learners. However, even though scaffolding helps guide and support students’ learning, scaffolding does not guarantee that students will learn and retain information while using a web-based learning system. What scaffolds do provide is a supportive learning environment for students with varied learning styles and learning levels.
Further research should be conducted on additional instructional strategies for WBLS to find out what instructional methods will help increase student academic achievement through web-based instruction.

**Shaping my WBLS Design**

After conducting these literature reviews I have decided that scaffolds are going to be an important aspect of my fifth grade Life Science web-based learning system. I will design my web-based learning system to include conceptual, metacognitive, procedural, and strategic scaffolds. Reflecting on Chang, Tarng, and Shin’s (2010) scaffolding experiment I have decided to add more textual and video resources to my WBLS instead of more graphics based on the results of their findings. Also, after reading Oboko and Njenga’s (2011) article that mainly focused on the importance of concept map scaffolds in WBLS I have decided to create graphic organizers for each of the weekly lessons with concept maps. This research has greatly influenced the design process of my WBLS.

**Conclusion & Reflection**

Overall, I have learned a great deal about web-based scaffolds. Although I already believed they were an important aspect of web-based instruction I did not realize the wide range of varied scaffolds. I was not aware that there were conceptual, metacognitive, procedural, and strategic scaffolds. This knowledge helped me differentiate my scaffolding techniques in my WBLS to help meet the needs of my varied learners.

Also, prior to reviewing the literature on scaffolding in WBLS, I thought that scaffolds would definitely help increase students’ academic achievement; however, not all research supports this theory. What researches do agree on is that scaffolding in traditional based classrooms or web-based learning systems positively impacts the learner’s completion of tasks.
and their step-by-step learning process but does not necessarily maximize the knowledge that they gain.

The literature also encouraged me to have my students recall some of their prior knowledge to help them build new knowledge onto existing ideas. Taking this idea, I decided to begin my whole Life Science WBLS with a lesson in which students need to recall information about the process of photosynthesis from what they learned previously from the grade level before. I then used my students’ prior knowledge about photosynthesis to build the whole unit on. I also used concept maps to help my students become aware of what they already knew and what they needed to modify.

In the future I would like to research more about different instructional strategies that positively affects students’ learning experiences with web-based instruction. I think this would be important to do because scaffolding is not the only important instructional strategy to use while designing a WBLS. I should conduct as much research as I can about the topic of designing and developing web-based learning systems to maximize the efficiency of the system and my students learning. Overall, my student’s learning outcome is of upmost importance while designing a WBLS.

This literature review paper truly impacted my outlook on designing a WBLS and showed me how important scaffolds are to help guide students in their learning process.
References


