Examples of Scaffolding and Chunking in Online and Blended Learning Environments
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Abstract

Scaffolding and chunking are instructional strategies designed to support the relationship of new information to prior knowledge in manageable sizes for the learner’s working memory. This paper defines scaffolding and chunking instructional strategies as they relate to information processing, describes how to determine and when to use scaffolding and chunking, and provides examples of when scaffolding and chunking have been used effectively in online and blended learning environments.

Scaffolding is based within Vygotsky’s Social Development Theory that proposes that learning occurs through participation in socially or culturally embedded experiences. A competent instructor presents information that activates the learner’s zone of proximal development just above the learner’s current skills level. Online and blended materials can include interactive strategies to help the learner elaborate on their prior knowledge. The interactive bridges are built within the educational materials or provided through interactions with other learners or the instructor.

Chunking is the process of taking individual units of information and grouping them into larger units. Working memory functions optimally with no more than five to nine pieces of information. By chunking information in larger blocks, the information becomes easier to move from working memory to permanent memory, be linked to prior knowledge, and be recalled at a later time.

The placement and use of instructional strategies is based upon where the learner demonstrates difficulty in relating the materials to prior knowledge or has difficulty recalling the information. Hierarchical analysis of the instructional materials, learner analysis, and evaluation of learner performance are techniques used to place the instructional strategies most effectively and efficiently for a proper balance of support and challenge to motivate the learner.

Keywords: Scaffolding, Chunking, Instructional Design, Online, Blended Learning
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Scaffolding and chunking are instructional strategies designed to support the relationship of new information to prior knowledge in manageable sizes for the learner’s working memory. These strategies are used to help gain the learner’s attention, help the information move through working memory and into long-term memory. The learner’s motivation for learning impacts the usefulness of the scaffolding and chunking of information on the success of the learner.

1 Motivation Continuum

Motivation for learning falls within the continuum of fear, attention, comfort, and boredom. Learners that perceive a topic to be too difficult fall in the area of fear and will become bored with the topic if they are not moved to the attention level. As the learner perceives an ability to master the topic, the learner moves into the comfort zone. If the learner finds the topic too easy, the learner will move into the boredom area. If a learner is fearful, the learner will also move to the boredom zone and not be attentive to the information presented. Scaffolding and chunking of the information will help manage the continuum for the learner to help balance the fear, attention, comfort, and boredom perceptions.

Figure 1. Motivation Continuum

2 The Information Processing Model

Even though many different interpretations of the information-processing model exist related to how a learner engages cognitive processes, a common assumption about stages represents the qualitative change of information from a stimulus to a response. Generally the assumptions involve perceiving, rehearsing, thinking, problem solving, remembering, forgetting, and imaging. An information-processing model of learning and memory begins with the input of information that is held briefly in the sensory register. If perception of a pattern occurs, the input moves to working memory. Miller (1956) identified that working memory is limited in capacity to seven plus or minus two units of information. If information in working memory is to move to long-term memory, rehearsal of the information should take place in working memory. Linkage to prior knowledge is another way

Figure 2. Information Processing Model
to move information from working memory to long-term memory. Information that is not linked or stored is lost from working memory.

3 Scaffolding and Chunking

Scaffolding is based within Vygotsky’s Social Development Theory (1987) that proposes that learning occurs through participation in socially or culturally embedded experiences. A competent instructor presents information that activates the learner’s zone of proximal development just above the learner’s current skills level. This activation using scaffolding enables the learner to do something beyond what the learner can do independently. This temporary framework provides the necessary support through instructional strategies to help the learner elaborate on their prior knowledge and be balanced between the attention and comfort levels of motivation. The interactive bridges are built within the educational materials or provided through interactions with other learners or the instructor.

Scaffolding and chunking are often used together. Chunking is the process of taking individual units of information and grouping them into larger units. Working memory functions optimally with no more than five to nine units of information. By chunking information in larger blocks to make less units of information, the information becomes easier to move from working memory to permanent memory, be linked to prior knowledge, and be recalled at a later time. Chunking of information in online and blended learning environments includes text-based techniques of breaking lessons into parts that are manageable for the learner, having short sections of the video available to support a technical process, or providing grouped segments of information that allow for rehearsal of the information before viewing the next segment.

Much like a scaffold is used to support workers to reach heights, instructional scaffolding is used to help a learner reach new levels of learning. Dr. Seuss, a popular children’s book author, used capitalization of text as a way to scaffold the learner to help with the concept of rhyming words (see Figure 3). These capital letters alert the learner to pay attention to the words. This simple scaffolding permits the learner to quickly identify the concept being presented.

Another example of text-based scaffolding used bolding of the parts of the text to draw the learner’s attention to the technical steps necessary to be followed. Figure 4 used the bolding technique and the breaking of instructions into smaller parts to draw attention to each step in the process. Figure 5 used optional suggestions to scaffold the learner to explore alternative processes. Optional activities are valuable for the learner that
is moving from the comfort zone to the boredom zone to help regain attention on
the topic.

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7. Inside the loop, get the lth record from the array:

   var rec = records[i];

8. Next, use the getAttribute() method to obtain the value of the name attribute for the record currently being processed by the loop:

   var name = rec.getAttribute("name");

   This code searches the node held in the rec variable for an attribute called name. Once found, the value held in that attribute is obtained and stored in the JavaScript variable called name. On the first pass through the loop, this value will be "Nittanytown". On the second pass, it will be "Witney", etc.

9. Add an almost identical statement to get the record's <population> attribute value:

   var pop = rec.getAttribute("population");

   When obtaining the latitude/longitude values, we need to make sure that the returned value gets stored as a number and not as a string. Attribute values are always returned as strings, so we need to use JavaScript's parseFloat() function to convert the string to a floating point number.

Figure 4. Use of Bolding to Scaffold Information and Chunking

The power of R lies in its ability to statistically manipulate such collections of data. For example:

> mean(y)
[1] 50.5

Even better, try these:

> hist(s)
> boxplot(s)

Now create a normally distributed set of random numbers:

> x = rnorm(1000)

and try examining histograms and boxplots.

Try This! (Optional) Not very exciting, but worth knowing... R recognizes both x = seq(1:100), and x <- seq(1:100) as equivalent ways to assign values to objects. As a beginner, you're likely to feel more comfortable with the = sign, but you should be aware of the other assignment operator as you will likely see it in the help materials. By the way, the help is reached by typing (for example) ?hist. Try it!

OK. For the purposes of this week's lesson, that's enough about R. If you are keen to learn more, there is a very useful introduction here. Next week, we'll be working with a package in R, which is optimised for dealing with spatial point pattern data, called spatstat. Again, you may want to install this package (use Packages - Install package(s)... from the menu bar) and experiment, if you have the time.

Figure 5. Use of Optional Suggestions to Scaffold Information

Another technique of scaffolding is using the scaffold as a reinforcement of the concept being presented. Video of classroom presentations may have hard-to-see graphics. A display of the graphic from the video to reinforce the information presented is a way to target the information for the learner and reinforce the information.

Figure 6. Reinforcement
Online and blended education environments use text based cueing and scaffolding techniques as an introduction to the new concepts. Links to outside materials are often used as a way to keep the online content current and relevant to the learners. Learners reading assignments may not have any idea of the key points that are most salient in the assignment. Providing question prompts to consider scaffolds the learner to pay attention to the desired concepts. Figures 7 and 8 use question prompts to scaffold the learner.

In addition to hyperlinks and question prompts, opportunity to discuss the information with classmates is another example of scaffolding. The learner reviews the other learners' comments and questions as a way to validate personal learning and to be exposed to the thoughts of classmates or peers. Figure 8 displays the use of learner comment posts to make the presentation more interactive and supportive.
Use of video to scaffold a learner to develop skills for a new concept has been increasing in adoption rates with the increased presence of broadband network capabilities. Presentation of video occurs in short clips that address a single concept or, as the learner masters the subject, in longer clips. Figure 9 displays short clips of videos with mouse rollovers to display the first page of the video clip. Figure 10 displays the use of a video to explain the concept presented in a graph. The video contains detailed explanations to help the learner interpret additional graphs presented in the lesson. Figure 11 displays a chunked video with less scaffolding. These videos were used after the introduction to the concepts to combine multiple concepts into a single video.
Lesson 4

6. Earthquake catalog data analysis, part 2
(Modified 08 Mar 2010)

Making frequency-magnitude plots

Earthquake populations approximately follow this relationship:

\[ \log N = a - bM. \]

This is a power-law equation in which \( N \) is the number of earthquakes whose magnitude exceeds \( M \) and \( a \) and \( b \) are constants. For the majority of earthquake catalogs, the constant \( b \) is approximately equal to 1. Note that the form of the equation above shows that \( b \) is a slope. When \( b = 1 \), this equation describes a line whose slope is about -1. Therefore, earthquakes of a given magnitude happen about 10 times as frequently as those one magnitude unit larger.

Seismologists can test the validity of the equation above using catalogs of earthquakes to make "frequency-magnitude diagrams." These diagrams show how many earthquakes of a given magnitude there are in a population of earthquakes.

Watch this!

Watch the video below to see a frequency-magnitude plot of one year's worth of worldwide earthquake data recorded by the U.S. Geological Survey earthquake catalog.

Figure 10. Example of Scaffolding using Video

Figure 11. Example of Scaffolding using Less Video and Chunked Information
4 Placement Analysis

The placement and use of instructional strategies is based upon where the learner demonstrates difficulty in relating the materials to prior knowledge or has difficulty recalling the information. Hierarchical analysis of the instructional materials, learner analysis through observations, and evaluation of learner performance using item analysis and examination of frequently asked questions are techniques used to place the instructional strategies most effectively and efficiently for a proper balance of support and challenge to motivate the learner. Using scaffolding or chunking for a learner that has mastered the information is an instructional development expense that is not value added. Scaffolding and chunking should be used to help with information processing in sections of the instruction where the learners have been identified to have difficulty or have demonstrated the inability to be able to master the information independently.

5 Bibliography

Miller, GA 1956, 'The magical number seven, plus or minus two: Some limits on our capacity for processing information', *Psychological Review*, vol. 63, pp. 81-97.

