Every Picture Tells a Story: The Roundhouse Process in the Digital Age

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Abstract

Roundhouse is a theory-driven, cognitive-based, visual story map designed to enhance long-term memory (Trowbridge & Wandersee, 1998). This type of graphic organizer requires learners to construct knowledge using “mindful” visual connections to replace often “mindless” practices involving recitation/memorization of abstract content. Students thereby create an observable schema of related concepts and icons in a sequential fashion. Roundhouse builds upon a student’s mental representation of what is already known, using a specified diagramming process called PDR (Plan – Diagram – Reflect). Studies have indicated that one of the benefits of using this technique is that students visualize their Roundhouse diagrams during assessment, promoting enhanced recall. Creativity, self-efficacy, and motivation for student understanding have been demonstrated in Roundhouse diagramming that incorporates digital technologies.

Using Roundhouse Diagramming in the Classroom

As early as 1996, Dwyer was pointing out that we learn using multiple modes. He commented that we learn 10% of what we read, 20% of what we hear, 30% of what we see, 50% of what we both see and hear, 70% of what is discussed with others, 80% of what we experience personally, and 95% of what we teach someone else (Dwyer, 1996). He was aware of the findings of Ausubel (1968), who described the need to provide ‘organizers’ for learners so they could build meaning by understanding the relationships between prior and new knowledge. Paivio’s research (1970) that explained how recall is enhanced when information is presented in both a verbal and visual fashion, also informed Dwyer about how we learn. Novak’s work in 1998 furthered our understanding of meaningful learning by demonstrating that the construction of meanings by forming connections, specifically visual connections that link prior knowledge to new information, promoted deep and meaningful learning.

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Novak's research (1998) also highlighted the different venues each learner takes to construct knowledge. When asked to draw a visual representation of what had been learned that previous moment, students' resulting drawing (the icon/concept pairing showing relationships) varied even though they had experienced the same instruction. Today, we realize that the use of techniques that make meaning by providing opportunities for learners to make connections between an icon and a concept, encourages retention of knowledge by tapping into preferred learning styles—a deeper processing of information than the recall of isolated facts and information (Gardner, 1983; Kolb, 1984; Gregorc, 1982.) The Roundhouse diagramming process builds upon the use of iconic mapping to promote student learning, and presents teachers with a powerful tool for teaching concepts. The process allows teachers a glimpse of what learners are thinking as they build conceptual knowledge, because the teacher can see what they are thinking as students draw a picture and connect it to a written or verbal explanation of that concept (Ward, 1999; Ward & Wandersee, 2001).

The Roundhouse diagram is a research-driven, cognitive-based, visual story map designed to enhance long-term memory (Trowbridge & Wandersee, 1998). This type of graphic organizer requires learners to construct knowledge using *mindful* visual connections to replace often *mindless* practices involving recitation/memorization of abstract content; students create an observable schema of related concepts and icons in a sequential fashion. The Roundhouse Diagramming Process (Plan – Diagram – Reflect, or PDR) provides learners with a procedure that maximizes knowledge construction when using the Roundhouse diagram—students develop knowledge through the storyboarding and iconic mapping process in which they visually represent knowledge, and then use the organizer to explain that knowledge to others.

The Roundhouse Diagramming Process has been used across the curriculum to help students break down difficult subject matter. James Wandersee, an education professor at Louisiana State University, introduced Roundhouse diagramming in 1994 (see Mintzes, Wandersee, & Novak, 1998). Later, Ward (1999) developed the PDR diagramming process for using the Roundhouse graphic organizer to promote subject matter learning. Four in-depth research studies have been conducted to investigate the effectiveness of the Roundhouse diagramming technique (Ward, 1999; Ward & Wandersee, 2001; Hackney & Ward, 2002; Ward & Lee, 2006), in which the findings indicate that the process is useful as a learning, instruction, and assessment tool. The findings of these studies also revealed positive results with a diverse

range of study participants, including middle and high school populations comprised of a range of participants (at-risk middle and high school students, mild-to-mild moderate self-contained special education children, as well as gifted learners). At-risk populations benefited from the strategy's simplicity in creating sequential knowledge, as well as the engagement in a process of using bright colors and images to trigger responses, which makes the activity pleasurable. Gifted learners benefited from this process by creating products with increased fluency, flexibility, originality, and elaboration (Torrance, 1992). The process is therefore appropriate for many types of learners because it taps into the imagination of the learners and promotes ownership of the product being designed. As well, the novelty of drawing pictures connected to ideas helps to motivate and focus a learner's attention during the learning process (Langer, 1997). "Lessons containing concrete information and evoking vivid images will be easier to comprehend and remember than lessons that are abstract and not image arousing" (Clark & Pavio, 1991, p. 173).

Introducing the Roundhouse Diagram

The Roundhouse diagram is composed of a circle within a circle. Circles are two-dimensional geometric figures, which are pleasing to the brain (Solso, 1994) and easy to recall. Many graphic organizers are circular because of the pleasurable cognitive effects. Our field of vision is circular making information easy to process when encompassed in a rounded figure. The curved inner line within the smaller circle can represent "yin and yang" or a comparison of ideas which lends itself to higher order thinking (Ward & Wandersee, 2001).

Figure 1: Blank Roundhouse Diagram (Ward & Wandersee, 2001)

The outer circle is composed of seven wedges. Seven wedges were chosen based on Miller's (1956) seminal research, which revealed that the normal human brain can easily recall seven chunks of information if related properly. The inclusion of sections, or *wedges*, in the diagram

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stimulates both inductive and deductive reasoning, as learners break down abstract concepts into their main ideas. The end result is a schema for organizing whole/part relationships, by facilitating the understanding of relevant attributes that define and differentiate concepts, so that the learner can comprehend “the big picture.”

The Process for Creating a Roundhouse Diagram

Construction of knowledge—just like a building—requires laying down a solid foundation, ensuring that the cement is in place for a sound creation. Therefore, Roundhouse diagramming requires a specific process to be followed. There are three phases to the Roundhouse diagramming process, or PDR: 1) an initial planning phase in which students use a worksheet to storyboard their ideas, 2) a diagramming phase in which students match icons to conceptual statements within the Roundhouse Diagram, and 3) a reflection phase, in which students express their knowledge in an essay, either written or verbal.

The P Phase of the P – D – R Roundhouse Diagramming Process: The Planning Phase

Because the construction of a Roundhouse diagram is similar to that of creating any visual presentation, a planning stage that allows the students to storyboard or script their ideas is an essential first step. Students are initially directed to fill out a worksheet prior to their computer-generated product (See Figure 1).

1. What are the main ideas you are exploring?
2. Write out your title using the “and” & “of” words.
3. Write down your goals and objectives for creating this diagram.
4. Take your entire concept and create seven wedges.
5. Paraphrase or “chunk” your concepts in each wedge.
6. Find clip-art, photos or draw icons that directly relate to each chunk of information
7. Make sure that each concept relates to the next one in a sequential manner

Figure 2: Roundhouse Diagram Worksheet (Ward, 1999)

The D Phase of the P – D – R Roundhouse Diagramming Process: The Diagramming Phase

In the second phase of the Roundhouse process, students storyboard the chunked concepts and related icons selected in the first phase with the Roundhouse Diagram Worksheet (Figure 2) onto a blank Roundhouse diagram (Figure 1). The learner sketches each sequence of concept and related icon into a wedge on the blank diagram. The sequence begins at the twelve o'clock position on the diagram and proceeds clockwise around the seven wedges. Each wedge must relate to the next one to form a network of connections.

All seven wedges are represented by a comprehensive title in the center of the diagram. The title deliberately uses the “and” & “of” words to make the student *think* and aid the learner in determining the verbiage for the main ideas contained in the outer circle of parts. Reading skills are used throughout the entire lesson as the students reflect on the main ideas, learn to write titles, actively paraphrase and summarize concepts, as well as to think critically and generate iconic images that trigger their memory of the relevant subject content. Students complete an individual diagram and use a checklist, the Mastery of Technique Checklist (See Figure 3), for self-evaluation purposes before submitting their work.

Skills	Yes	No	N/A	Needs Improvement
1. Are goals stated clearly?				
2. Is the title comprehensive?				
3. Are the main ideas covered?				
4. Are 5-7 wedges clearly defined?				
5. Are the concepts accurate?				
6. Is the sequence accurate?				
7. Is there an icon/concept relationship in each wedge?				
8. Is spelling and grammar correct?				
9. Is the space well utilized in each wedge?				
10. Is the design aesthetically pleasing?				

Figure 3: Mastery of Technique Checklist (Ward, 1999)

There are two reasons for having students complete the drawing process individually. First, if the student originally created the diagram they will have no problem remembering it later when tested (Ward & Lee, 2006). Secondly, individual feedback, a component of any creative

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endeavor, is more easily provided. Individual drawings ensure a teacher will be able to more easily observe how each student is answering the questions from the checklist, in order to assess conceptual understanding. Re-teaching can take place immediately, if necessary, for it is obvious to the teacher that the student either understands or has a misconception.

An essential component of the Diagramming phase is the facilitation of the drawing process by the teacher through student interviews. Although the student is using the Mastery of Technique checklist to self-evaluate, teacher feedback regarding accuracy of conceptual understanding is provided through interviews of the learner while constructing the Roundhouse diagram. The interviewing process allows the teacher to determine what a child is thinking in order to correct misconceptions, and usually includes simple questions, such as “Tell me about your picture” or “What does this icon mean?” For example, Figure 4 illustrates two different versions of Roundhouse diagrams constructed by students that explain the concept of magnetism – both are conceptually correct. During the interview, the teacher is able to determine which concepts are still missing or need reinforcement. (See the interactive versions of explaining conceptual understandings of magnetism in the examples of student-constructed Roundhouse diagrams at <http://www.handy4class.com/roundhouse/magnetism> and <http://www.handy4class.com/roundhouse/magnetism2>.)

Figure 4. Two examples of student-created Roundhouse diagrams for explaining conceptual understandings of magnetism

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Teacher interaction with each child is crucial in this step. A child can pretend to read a passage about the scientific concept of ‘producers,’ but, if asked to draw a picture, the picture will tell the story of what the child is understanding. For example, if the teacher is discussing carnivores and the child draws a picture of a deer, it becomes apparent that the child has a misconception. In another instance, perhaps the student is asked to draw a diagram of the Food Chain. If the student does not begin with a producer, the teacher immediately knows that there is a misunderstanding. The misconception can also be revealed in the narrative created by the student. If a child draws a picture of an animal, and labels it a *producer*, the child could interpret that to mean the animal *reproduces* other animals. A misconception has taken place. Pictures enhance communication between student and teacher, allowing the teacher to address each individual picture and query how the pictures relate to the learning task in the mind of the learner (Ward & Lee, 2006). Interviewing the learner can help clarify false notions, while simultaneously providing immediate feedback and any necessary re-teaching.

The R Phase of the P – D – R Roundhouse Diagramming Process: The Reflection Phase

The last phase is reflection. After the child has completed the diagram and received feedback from the teacher, the student must explain in his/her own words what the diagram means; therefore, the final follow-up activity is to have students write a reflection essay that tells the story of their diagram.

The student begins describing the information contained in the wedge in the 12 o’clock position and goes clockwise. Each wedge is described with a written explanation of what their icons and chunking of concepts means to them from their own perspective (See the diagram and related reflection in Figure 6). This final activity in the diagramming process promotes the expression of knowledge clearly in written form, which stimulates deep processing of the information. The research studies on Roundhouse (Ward, 1999; Ward & Wandersee, 2001; Hackney & Ward, 2002; Ward & Lee, 2006) revealed that a child is able to complete a well-written description of their diagram when using the diagram to support this writing.

Once the reflection essay is complete, the teacher uses the Roundhouse diagram with the essay to determine whether the Roundhouse diagramming process is making a difference in the

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student's cognitive knowledge. To analyze a diagram, the teacher uses the Roundhouse Assessment Rubric (See Figure 5) to assess important elements of knowledge.

Criteria	2	1	0
Main ideas explained in reflection	All of the main ideas included in the diagram are included in the reflection.	Reflection includes at least five of the seven main ideas illustrated in the diagram.	Reflection includes less than five of the seven main ideas illustrated in the diagram.
Explanations relate directly to icons on diagram	All explanations in the reflection relate directly to the icons in the diagram.	At least five of the seven wedges explained in the reflection relate directly to the icons in the diagram.	Less than five of the seven wedges explained in the reflection relate directly to the icons in the diagram.
Explanations relate one wedge to the next wedge in the sequence	All wedges relate meaningfully to the next wedge in the sequence.	At least five of the seven wedges relate meaningfully to the next wedge in the sequence.	Less than five of the wedges do not meaningfully connect to the next wedge in the sequence.
Concept Application (icon chosen for the diagram accurately represents the content)	All icons chosen for the diagram and their related concept statements (as explained in the reflection) are consistently matched.	At least five of the seven icons chosen for the diagram and their related concept statements (as explained in the reflection) are consistently matched.	Reflection includes less than five icons that are consistently matched to the explanations of the concept statements.
Originality statements – in their own words; is the idea unique?	Reflection represents original thinking by the student in expressing concepts and relating icons to concepts in their own words and in a unique fashion.	Reflection represents similar thinking by student to other students, but expressions of individual are stated in their own words and in a unique fashion.	Reflection statements are not unique; expressions are copied from classmates or other sources.
Sequence – tell the story of their Roundhouse in the order of the wedges in the Roundhouse	Reflection tells the story of their Roundhouse in the order of the wedges in the Roundhouse, with each wedge connecting to the next.	Reflection tells the story of their Roundhouse in the order of at least five of the seven wedges in the Roundhouse.	Reflection does not tell the story of their Roundhouse in the order of the wedges in the Roundhouse, OR tells the story of the Roundhouse in sequence with less than five of the wedges.
Elaborate – number of ideas and fluency of ideas	Reflection shows evidence of research and multiple ideas that highlight a deep understanding of the topic.	Reflection shows evidence of research or a basic understanding of the topic.	Reflection shows no evidence of research, or shows misconceptions about the topic.
Clarity of expression	All sentences in the reflection do not clearly express overall ideas for audience understanding.	Some sentences in the reflection do not clearly express overall ideas for audience understanding.	Few sentences of the reflection clearly express overall ideas for audience understanding.
Grammar/spelling	No mistakes in spelling or grammar.	Only a few mistakes in spelling and grammar.	Many mistakes in spelling and grammar.

Figure 5. Assessment Rubric for Reflection Essay from the P – D – R Roundhouse diagramming process

Integrating Technology into the Construction of a Roundhouse Diagram

Although the Roundhouse Diagramming process was created for use with paper and pencil, the incorporation of technology tools into the process to assist with storyboarding or

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diagram construction have been effective (Ward & Lee, 2006). The addition of animation, cartooning, sound effects, music, video clips, transitions and bright colors to the Roundhouse diagram, supports learners with even more ways to extend and enhance their creative expression of the concepts, while using real world tools that 21st century learners deem relevant (Prensky, 2005). Perceptions among participants in the studies where they enhanced their Roundhouse diagrams with graphics, video, animation, and sound, indicated that the use of these elements enabled them to more accurately express conceptual knowledge by selecting and acquiring icons that more closely resembled the ideas that they wished to present (Ward & Lee, 2006). Additionally, Ward and Lee (2006) further found that participants were more satisfied with the final Roundhouse product and felt that they had been allowed more choices for creative expression.

Enhancing the Roundhouse diagram with the multimedia components engages students in a learning environment that promotes creativity through the use of real world tools, while activating preferred learning styles and multiple intelligences (Gardner, 1983) in an interdisciplinary project-based learning experience (The Multimedia Project, 2001). For example, Figure 6 illustrates an interactive Roundhouse diagram that incorporates sound, animations, digital images (photography and clipart), and sequential transitions to present the wedges one at a time. In this example, the Roundhouse diagram was constructed using MS PowerPoint, and an additional slide was added for the reflection statement. (Although Figure 6 presents the 2D version of the Roundhouse diagram, to view the interactive components of the diagram, visit <http://www.handy4class.com/roundhouse/butterfly/>).

Figure 6: An Interactive Roundhouse (Ward & Figg, 2005)

In the studies on students' use of the Roundhouse diagramming process (Ward & Wandersee, 2001; Hackney & Ward, 2002), one drawback to the use of the strategy in instruction was student intimidation with the drawing process, specifically for students in the middle grades, where fears of having classmates ridicule what was drawn occurred. Using technology eliminates student fear of not having their drawings look aesthetically pleasing, thus allowing students to focus on the conceptual knowledge, rather than worrying about how the final product would be judged by their peers. For example, Figure 7 illustrates an interactive Roundhouse diagram that uses clipart and animations to present conceptual knowledge of heat. The addition of popular music clips and sounds engages learners in learning that conceptual knowledge through a multi-sensory experience. (The interactive version of the Roundhouse diagram can be viewed at <http://www.handy4class.com/roundhouse/heat>.)

Figure 7: Student-created Roundhouse Diagram, Heat

In addition to teaching conceptual knowledge, the use of technologically enhanced Roundhouse diagrams can also be used to teach 21st century digital literacy skills (Partnership for 21st Century Learning, n.d.). Using media to build a student project requires learners to be aware of copyright and proper attribution of incorporated images, video clips, animations, and sound. The student-created roundhouse diagram shown in Figure 8 explains how vibrations cause sound and uses a 15 second song trailer to introduce the concept. Clipart and text animations are timed to enter the screen when the song describes those concepts. All media are properly credited in the diagram's bibliography. (Interactive version available at <http://www.handy4class.com/roundhouse/soundsofenergy.>)

Figure 8: Student-created Roundhouse Diagram, Sound of Energy

Conclusion

Constructing digital iconic representations, such as Roundhouse diagrams, requires students to internalize, not memorize, abstract content in a way that is personal and meaningful (Robin, 2008; Sadik, 2008; Banister, Hodges, & Michalski, 2005; Kenny, 2007). Pictures become symbols that represent actual events (Atkinson & Shiffrin, 1968), promoting ease of recall for assessment purposes or making other conceptual connections. The Roundhouse diagramming process (P – D – R) is useful in developing deep student conceptual understanding that is accurate and complete. In the same way, advertising icons and logos (such as the five rings of the Olympics) trigger visualization in the thinking of an event (e.g., many individuals visualize the five rings when thinking about the Olympics), students visualize their Roundhouse diagram, and use the images and related conceptual statements from the diagram to answer test or quiz questions (Ward & Lee, 2006). Enhancing this powerful teaching technique with technology serves to engage learners in an interactive learning environment that taps into multiple learning styles, making the learning even more relevant and motivational to 21st century learners.

Every story has an author, a beginning (focus), main ideas, imagery (written or mental), a sequence, and a conclusion. Learning is enhanced through stories (Collins & Cooper, 1997), and every Roundhouse diagram tells a story of what a student understands about concepts (Ward, 1999). Therefore, we conclude with a story, in Roundhouse diagram format, about the benefits and advantages of using the Roundhouse diagram to teach conceptual knowledge. Use this diagram (Figure 9) to construct your own reflection for conceptual understanding of how the Roundhouse diagramming process promotes information processing and recalling main ideas.

Figure 9: Goals of Using Roundhouse Diagramming: Advantages and Features of Roundhouse Diagramming (Ward, 2005)

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