Application of Graphic Organizers in Problem-Based Learning

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Abstract

Graphic organizers have many types and have been widely researched for their effectiveness in improving learning outcomes for students. The paper begins with an introduction to graphic organizers. The literature review addresses the theoretical support of graphic organizers in educational practice. Based on evidence from researches and studies, the paper proposes the application of graphic organizers in Problem-Based Learning. The paper briefly introduces PBL and proceeds to identify ways that graphic organizers can support PBL.

Key words: Graphic organizers, Learning Outcomes, Problem-Based Learning

Graphic Organizers and Theoretical Foundations

Graphic organizers are defined as visual or graphic displays that show visual interrelationships of superordinate and subordinate ideas using spatial arrangements, geometric shapes, lines, and arrows to portray the content structure and demonstrate key relationships between concepts (Darch, Carnine & Kameenui, 1986). Graphic organizers are developed based on the Cognitive Theory of Ausubel (1968). According to Ausubel (1968), an individual’s cognitive structure is a major variable in learning new materials. He argued that new meanings are acquired only when they are related to previous learned information. Ausubel introduced advance organizers to support this process. Graphic organizers including spatial and visual arrangements depict the structure of information and provide prerequisite information for new materials. Ausubel’s theory regarding the effectiveness of graphic organizers in promoting learning was examined in the literature.
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(Alvermann, 1981; Darch & Carnine, 1986; Darch, Carnine, & Kameenui, 1986; Hawk, 1986). Five theoretical foundations guide the research in the application of graphic organizers: schema theory, text structure awareness, information processing theory, cognitive load theory and activity theory.

**Schema Theory and Graphic Organizers**

Schemata were initially introduced into psychology and education through the work of the British psychologist Sir Frederic Bartlett. Bartlett (1932) proposed that people have schemata, or unconscious mental structures, that represent an individual’s generic knowledge about the world.

Anderson (1978) pointed out that schemata provided a form of representation for complex knowledge and that the construct provided a principled account of how old knowledge might influence the acquisition of new knowledge. Anderson (1978) believed that presentation of a graphic organizer before reading activates the prerequisite information of a student while presenting content information and organizing key concepts schematically, and provides a frame for the new knowledge.

**Text Structure Awareness and Graphic Organizers**

Ornstein (1994) defines the structure of text as the main ideas of the text, how information is organized, as well as the verbal and textual cues (or pedagogical aids) that help organize and bring unity to the text. Students’ awareness of different types of text structures will help them to infer the information which is necessary to comprehend from the text.
The effectiveness of graphic organizers is explained based on text structure awareness (Alvermann, 1981, 1982; Berkowitz, 1986; Darch & Carnine, 1986; Darch & Eaves, 1986). Through presenting visualized content of the text, graphic organizers provide information about the sequence and structure of the text and let students pay attention to the important units of the text (Anderson & Armbruster, 1984).

**Information Processing Theory and Graphic Organizers**

Information processing theory is a group of theoretical frameworks that address how humans receive, think about, mentally modify, and remember information, and how these processes change over the course of development (McDevitt & Ormrod, 2004). The information processing model (IPM) developed in 1950s is one of the most popular models based on information processing theory. The IPM consists of three main components: sensory memory, working memory, and long term memory (Schraw, 2006).

Based on information processing theory, the use of graphic organizers enables textual information to be dually encoded—both verbally and spatially (Paivio, 1983). When verbal information is not successful in the retrieval of information given in the text, the spatial processing becomes a second stratum cue (Kulhavy, Stock, Peterson, Pridemore, & Klein, 1992). Moreover, visual presentation of core components of the information makes it possible to spend less effort in processing the information. Therefore, it facilitates information processing (Robinson, 1998).

**Cognitive Load Theory and Graphic Organizers**

According to cognitive load theory, learning occurs when learners engage in appropriate cognitive processes (Chandler & Sweller, 1991). Appropriate cognitive
processes can be attained by essential processing and generative processing. In essential processing, a learner is engaged by mental representation of the material determined by inherent complexity of the material, whereas in generative processing, learner is engaged in mental activities relating to deeper cognitive processes of the material (Stull & Mayer, 2007).

Cognitive load theory theories are best applied in the area of instructional design of cognitively complex or technically challenging material. Cognitive load theory has many implications in the design of learning materials which must, if they are to be effective, keep cognitive load of learners at a minimum during the learning process. While in the past the theory has been applied primarily to technical areas, it is now being applied to more language-based discursive areas.

As related to cognitive load theory, the presentation of graphic organizers facilitates the students’ engagement in generative processing by giving information on how the text was organized (Stull & Mayer, 2007).

*Activity Theory and Graphic Organizers*

Activity Theory was developed by the Russian psychologists Vygotsky, Rubinshtein, Leont'ev, and others with work beginning in the 1920’s (Kaptelinin, Kuutti, Bannon, 1995). According to this theory, when students engage in productive learning activities, deep learning is acquired (Kirschner, Sweller, & Clark, 2006).

Stull and Mayer (2007) explain the effectiveness of constructing graphic organizers based on activity theory. Constructing graphic organizers is a productive learning activity. The students select relevant ideas from the text, organize the ideas in
the graphic organizer, and show relations of different concepts. This process facilitates deep learning.

PERFECT Model and Graphic Organizers

Problem-Based Learning

Educational practice is increasingly paying attention to advancing skills for knowledge creation and collaboration, which is supported by problem-based activities that simulate the practices of professional or scientific communities (Carey & Smith, 1995). Student-centered approaches, especially Problem-Based Learning (PBL), has been the focus of many developments in teaching and learning facilitation in recent years.

PBL uses real-life problems modeled after a contemporary or historical case to engage students as they pursue specified learning outcomes that are in line with academic standards or course objectives (Stepien & Pyke, 1997). Students work through the problem by exploring the issues involved, formulating questions, conducting research, and considering possible solutions to the problems. The instructor acts as a facilitator during the process.

It has been claimed that PBL produces independent learners who are motivated, engaged in deep learning, work as a team, and develop effective strategies, skills and knowledge for life-long learning and professional work (Lorna & Chris 2006).

PERFECT Model

Based on the principles of PBL and collaborative learning, the author developed an instructional design model tentatively named PERFECT (Figure 1), for demonstrating
Figure 1 PERFECT Instructional Design Model based on PBL
an example of PBL model in a workshop. This model is a synthesis of PBL strategies and characteristics. It doesn’t indicate that the model is perfect; rather, it indicates that both instruction and learning are an ongoing process to achieving perfection.

There are seven components in this model: Prepare, Experience, Relate, Frame, Examine, Customize and Transfer. Each component comprises different learning activities. All these activities are designed based on PBL.

**Graphic Organizers and PERFECT Model**

In PBL, learners are required to find, organize, and present the information that they need to solve real life problems. Learners need to synthesize information so that they can complete their assignment efficiently and successfully. They must be information processors in their life beyond school. Graphic organizers are a powerful tool for learners to work through the problem in PBL regarding the information processing.

Using graphic organizers can help learners build their own knowledge and reflect on how new information links to their mental framework or schema of the world. For each component in PERFECT model, graphic organizers can help learners synthesize information during their problem-solving process.

**Prepare.** At this stage, the instructor will inform learners of their learning objectives and help them understand what they will do and why. Learners will also be prepared for the learning activities with necessary resources for the new knowledge and skills to be learned. Advanced organizers can be used to help learners build connections between prior knowledge and new knowledge.
An Advance organizer is a presentation of information (either verbal or visual) that builds connections between prior knowledge and new knowledge. An expository Advance organizer provides generalization of basic concepts to facilitate learners in learning new and unfamiliar materials. A comparative Advance organizer compares and contrasts prior knowledge and new knowledge to help learners integrate new ideas into relatively familiar ideas. Ausubel (1960) suggested that Advance organizers might foster meaningful learning by presenting a global representation of the knowledge to be learned and help learners understand interconnections among the basic concepts in the domain. For example, Figure 2 is an Advance organizer that shows relationships of different concepts and can help build connection between a learner’s prior knowledge and new knowledge to be learned.

**Experience.** At this stage, learners are situated in an authentic scenario where they are provided a problem. They need to analyze the causes and effects and the interrelationships among the attributes of the problem. The major function of graphic organizers here is to define the problem.

Fishbone diagrams help to identify the problem causes and interrelationships between the causes. A fishbone diagram, sometimes called a herringbone map, is a type of graphic organizer used to explore the many aspects or effects of a complex topic. It helps the learners to organize their thoughts in a clear and visual way. When the scenario requires the learners to investigate the attributes associated with a complex topic and obtaining details on each of the attributes, the learners can develop a fish bone diagram to help them focus on the topic, review what they already know in order to organize their knowledge, and monitor their growing comprehension of the problem. It also helps to
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clarify the areas where the learners must investigate more. Figure 3 demonstrates the basic idea of how a fishbone diagram could be used to analyze the causes and effects of a problem.

Some other graphic organizers can also be used at this stage, such as Chain of Events which helps learners analyze the components of the problem, and Cycle Map which shows interactions between events.

Figure 3 Fishbone diagram summarizing sources of “waste” observed in NHS day surgery pipeline

**Relate.** At this stage, learners start to relate the problem to existing resources and identify tasks and necessary new resources. Graphic organizers can be used to analyze the information seeking strategies in this process.
Cluster diagrams help learners generate ideas about potential tasks and possible sources of information. A cluster diagram, sometimes called cloud diagram, is a type of non-linear graphic organizer that helps to systematize ideas based upon a central topic. Learners can more easily brainstorm a theme, come up with an idea, or explore a new subject by using a cluster diagram.

Other useful graphic organizers at this stage include Compare and contrast Organizers, which help to select the best sources, and Spider Maps, which help to determine key words for searching information.

Figure 4 A Cluster Diagram

Parnaby & Towill, 2008
Frame. At this stage, learners start to acquire needed resources and engage in framing the solutions for the problem. Graphic organizers here can be used to compare and contrast information sources, identify similarities and differences, pull together ideas, articulate the problem and consider multiple solutions and possible results, and map out presentations and so on. Useful graphic organizers at this stage include Compare and contrast diagram, Venn diagram, Cluster diagram, Problem and solution diagram and Storyboard. Figure 5 is an example of what a Problem and solution diagram could look like.

Examine. At this stage, learners start to examine their solutions and synthesize their experiences. Graphic organizers such as Compare and contrast diagram, Venn
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diagram and Interaction outline can help them present their solutions for peer review, analyze the solutions of other groups and reflect on their problem solving experiences. Figure 6 is an example of how a graphic organizer can be used to present solutions effectively.

![Graphic Organizer for the Presentation of Solution](image)

Parnaby & Towill, 2008

Figure 6 A Graphic Organizer for the Presentation of Solution

**Customize and Transfer.** At this stage, learners customize their solutions and apply the solutions to real world problems. Cluster Diagrams can be used to identify new information needed. Fishbone Diagram can be used to analyze the causes of the problems existing in the solutions. Venn Diagrams can be used to compare and contrast the learners’ solutions with experts’ solutions so that they can notice the areas in which they need to make improvements.
Conclusions

PBL is a student-centered approach. Integrating the use of graphic organizers into PBL approach may enable students to be more engaged in learning and collaborate with each other more effectively. Graphic organizers help learners by providing visual models for sorting and processing information (Nancy & Ellen, 2010). In the process of developing graphic organizers, the learners are constructing and negotiating meaning, sharing information, and making presentations to each other. Thus, they identify and summarize new concepts in ways that are meaningful, integrated, value-based, and challenging (National Council for the Social Studies 1994).
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