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The “Big Picture” of Thematic Multimedia Information Representation in Enhancing Learners’ Critical Thinking and History Reasoning

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Abstract

This paper discusses the implementation of interactive multimedia and concept map as the thematic information representation to enhance students’ critical thinking and history reasoning. We designed a structured thematic representation of history learning with an interactive concept map based on the cognitive theory of multimedia learning and cognitive information processing theory as the underlying theories. The six components in history reasoning theoretical framework and concept map strategy are implemented in the development of web-based multimedia learning system. Multimedia information representation with visual and verbal information compensates for the massive load of history information, which is presented with an interactive knowledge structure. Learning history in-depth is not just fully accepting the facts and data from the past but also to conduct a historical analysis and interpretation as well as to rephrase and represent the historical concept with one’s own point of view in a well-structured form. Thus, in this study, we discuss the strategy of how the integration of a concept map provides the “big picture” to organize, restructure, and convey the learning content thematically. This interactive concept map incorporates multimedia information representation with regard to learners’ emergent cognitive processes for history reasoning in themes. This thematic approach of the concept map provides a forecast to improve conceptual understanding, relate history to a broader context, and implement it for future events.

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1. Introduction

The traditional organization of a history learning content that relates to the concept of date and time usually involves the memorization of biographical events by the learners (Howson, 2009; Howson & Shemilt, 2011; Lee, 2004; Masterman, 2002). This instruction method indirectly causes the students to think chronologically. When the students think chronologically, they tend to think in series of steps and actions, reasons, and represent the historical content and arguments narratively.

However, the problem that is often raised is, the history questions that require students to interpret, compare, and contrast, as well as think in a broad context from diverse perspectives such as political, social and economic, are less emphasized by educators. The organization of historical contexts should consider this challenge by integrating suitable information representation approach: designing an integrative interactive multimedia and metacognitive map on overarching idea of organization to develop the knowledge structure in the learners’ mind. Thus, in this study, the thematic approach for the instructional design of historical content suggested the usage of concept map that consists of semantic unit (unit of meaning) to compensate for the learners’ cognitive load. The descriptive and peripheral details of historical events are represented by using interactive multimedia such as video, thinking map, process diagram, and text.

1.1. Thematic Information Representation

The historical themes refer to the ideas or topics of discussion that proceed through historical periods (Brian & Leah, 2010). It was a big idea to connect integrated area in relevant, rich, related, rigorous, and recursive means in developing the curriculum (Fogarty, 1997). Usually, there are two general themes builders: a) subject themes and b) conceptual themes. Subject themes involve historical topics or events (e.g., the civilization of Mesopotamia) that can be explored through the curriculum area (e.g., the contribution of Mesopotamian civilization toward science and technology areas) while the conceptual themes involve broad topics that underlie many ideas. Organization and teaching of the history curriculum in thematic form shows connection of important themes in history such as politics, culture, economics, social, environment, or others of those particular periods and regions of the world that recurred over time. Both types of themes are supported by the basic historical concepts, which are metaconcept and substantive concept (Counsell, 2000; Limon 2002; Van Drie & Van Boxtel, 2008). Substantive concepts refer to constructions that organize the past through description (e.g., historical phenomena, individuals, events, and periods included in a historical event). Metaconcept is used as a guide for asking focus questions, to describe the causal effect of historical events, to describe processes of change and continuity, to compare, and to explain historical phenomena.

From the brain-based learning perspective, it is human nature to seek patterns to create meaning and understanding (Caine & Caine, 1991; Jensen, 2000). The thematic structure of instruction connects the ideas, concepts, themes, subthemes, and focus questions together to form the large intercorrelate structure or semantic meaning. The connection of ideas and concepts requires the immersion of rich context of imagery and motion picture to enhance the brain-seeking pattern strength (Davies & Rajni, 2010). When learning through thematic approach, students may see different values, perspectives, and possible outcomes. The learning content that is presented in thematic units challenges students to think around the themes rather than just presenting discretely in separate subjects (Davies, 2001). This may help to compensate for the load of history information which challenges students to think, especially in a multiple-text that leads to the learning frustration due to cognitive load. The patterning or chunking of information assists students to construct and sort new knowledge in an organized manner and creative meaning. This allows for greater internalization and recall of this information can be maximized (Wagmeister & Shifrin, 2000).

In simple words, the history lessons that are designed thematically and represented using appropriate interactive multimedia in relation to the concepts and ideas would provide meaningful learning if the learners have made the mental model in their mind. However, the limited working memory capacity in processing the incoming information and blending it with existing long-term knowledge is not easy, especially when dealing with loads of information. As a result, this may impede their cognitive thinking.
Pollock (2007) stated that “in order for the mind to recall information, the mind after spending time being immersed in a topic organizes and reorganizes memory point to retrieve and use it later spontaneously in an independent application”. This implies that when humans hear, read, experience, or view information, they will probably use that information independently with the aim of rehearsing it using information representation, asking focus questions, or recalling the iconic images or keywords. During the transferring and processing of receiving information, the verbal-visual memory and episodic or semantic memory will be formulated. This is in conjunction with the cognitive theory of multimedia learning (CTML) and cognitive information processing in which incoming information (e.g., visual, auditory, verbal) will be processed in working memory or short-term memory, form semantic memory, iconic meaning, or episodic memory. With repeated rehearsal, these memories will be encoded and stored as long-term memory. From the practical perspective, in order to build a knowledge model and achieve meaningful learning, the learners must be exposed to the multimedia, create, and integrate the conceptual knowledge of representation (Schnotz & Bannert, 2003).

Thus, in this study, we suggest the implementation of concept map and interactive multimedia in interpreting the thematic information representation. We integrate three strategies in the design and development of the interactive concept map for history learning, which are:

- Historical reasoning theoretical framework
- Principles of CTML theory
- Concept map strategy

2. Thematic Information Representation in History Learning by using Concept Map Strategy

Concept maps such as semantic networks or mind map tools connect two concepts within the hierarchical relationships among the topics and themes while incorporating the supporting details (Novak & Cañas, 2008). Although concept maps can facilitate collaborative activities that encourage communication among the learners and negotiation of meaning (Roth & Roychoudhury, 1994), yet concept maps alone cannot handle complex information. Another issue is concerned with the knowledge of concepts in explaining the historical phenomenon and relationships. Historical formation is not only emphasized in examining to what extent the students can place the historical events in sequential and chronological order, but also investigate the history thematically. Historical reasoning framework by Van Drie and Van Boxtel (2008) suggested six components as the guidelines and the “skeleton” of development of concept map, while other peripheral details of historical content are represented using interactive multimedia.

In this study, the topic on the civilization of Mesopotamia is taken as a subject unit. First, we implement the historical reasoning theoretical framework as the macro approach or “skeleton” to the concept map. Theoretical framework of historical reasoning provides a concise historical learning view which consists of six components: asking historical questions, use of sources, contextualization, argumentation, use of substantive concepts, and metaconcepts. The ability of students in arguing about the historical information of the past by providing reasonable and critical judgment is highly emphasized in this theoretical framework. We consider the contextualization as the knowledge structure of how the historical concept would be organized, elaboration of the events and description of the changes, and comparison of the historical sources.

The application of substantive and metaconcept forms the contextualization of the historical content. The exploration of the specific themes according to the diversity of civilization as the central point of discussion encourages the students to raise questions, refine, analyze repeatedly, and compare with other civilizations regarding these themes. By linking a particular historical event with the present and predicting future trends, people, location, and period, students may learn from the inquiry by asking suitable questions that indirectly encourage them to search for answers, the concrete meaning, and knowledge constructed through the processes of inquiry. The substantives concepts lead to metaconcepts which show the “big picture” of historical content. In this study, description of historical events is represented in multimodal information representation such as historical pictures, animations, video, focus questions, and thinking (e.g., a flow map that shows the causal effect of process).
Multimedia information representation and interactive multimedia (IMM) handle the complex context of the interactive concept map in which the information is represented in the visual and multimedia format semantically. This substantive concept incorporates the concept map to facilitate the visualization of historical phenomena and causal relationship, while the metaconcept involves the event changes, patterns of the past, and the judgment used to determine the reliability of the past (Van Drie & Van Boxtel, 2008). It can be represented using the cross-link, causal diagram, matrices comparing period, and linking words. This concept map offers a method of displaying the “big picture” of theme and extends to subthemes respectively.

Thus, in this study, for the formulation of the learning content (contextualization and use of metaconcept and substantive concept), we develop a concept map that includes several key features arranged in a hierarchical structure. We use Cmap tools software to create a hierarchical structure of concept map (Figure 1) that consists of substantive and metaconcept with cross-link (Figure 1 [A]) to form a meaning structure (Figure 1 [B]). The themes of historical topics (e.g., civilization of Mesopotamia) are the learning content. We add iconic images (e.g., Figure 1[C]) to invoke learners’ iconic memory. Besides, we add the symbol of question mark to represent the focus questions (e.g., Figure 1[D]) to be answered by the learners on each historical event. This is in line with the historical reasoning theoretical framework that asking the relevant questions may help to invoke the learners’ HOTs. While answering the questions, they may explore the concept map and search for the sources and evidence in supporting their arguments.

Fig. 1. (a) Cross-link; (b) Meaning structure; (c) Iconic image; (d) Symbol of focus questions.

3. Theoretical Perspectives of Implementation of Multimedia information Representation

When relating the cognitive process with multiple representation learning, Paivio's dual coding theory, Mayer’s cognitive theory of multimedia learning (Mayer, 2001; Paivio, 1991), and cognitive load theory (Kirschner, 2002;
Sweller, Van Merriënboer, & Paas, 1998) are the most commonly used approaches (Prangsma, 2007). Dual coding theory states that humans recall information and the recognition of information can be enhanced by incorporating non-verbal information with verbal information. Verbal channel processes the language while non-verbal focuses on representation of non-verbal events such as the use of pictures. Pictures accompanied with text as the explanatory text can benefit the learning process, as pictures can convey information verbally and visually, but cannot convey a lot of information, especially when describing the causal-effect relationships of past events with the present. Dual coding theory is generalizable to the natural sciences that consist of specific concrete concepts. History subject is related with humanities that consist of abstract historical concepts such as metaconcept and substantive concept. It involves the processes of history reasoning and critical thinking that require the learners to explain the historical phenomena, showing the causal effect of events chronologically that cannot be represented with the visual language (e.g., arrows, shapes in flowcharts, cycle diagram, and schematic representation) in the whole picture as the natural science representation does. Different fields of study have different possibilities of the application of multimodal representation (De Westelinck, Valcke, De Craene, & Kirschner, 2005). Different information representation and organization has an effect on the human cognitive process. Thus, in this study, we apply CTML in designing the web-based history learning application.

In order to convey a great deal of information, multimedia elements such as videos, images, and descriptive text are included. The combination of multimedia provides interactive ways of information representation and invokes the thinking of learners through learning processes and presents the abstract historical concept in explicit ways. Figure 2 shows the implementation of interactive multimedia with the pop-up window showing the details.

Fig. 2. Pop-up window showing the description of a historical event.
Fig. 3. Pop-up window showing a video.

Table 1 summarizes the strategy map to the historical concept and example. The concept map is implemented as a visualization tool that represents the metaconcept and substantive concept with the aim of applying the interactive multimedia to describe the events or process in detail. By considering the limitation of the working memory in processing one or two concepts in a moment, we organize one or more metaconcept, substantive concept, show the causal-effect relationships of historical events with a cross-link (Figure 1 [A]), and create a semantic meaning (Figure 1 [B]). All of these elements form a semantic meaning or cognitive structure that can be easily recalled and understood by the learners.

<table>
<thead>
<tr>
<th>Components in Interactive Concept Map</th>
<th>Multimedia/Multimodal Information Representation</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substantive Concept</td>
<td>Keywords</td>
<td>1) Civilization of Mesopotamia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2) Contribution of Mesopotamia toward the world</td>
</tr>
<tr>
<td>Theme and Sub-themes</td>
<td>Keywords</td>
<td>1) Social organization (See Figure 1 [D])</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2) Government</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3) Religion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4) The job specialization</td>
</tr>
<tr>
<td>Meta-concept</td>
<td>Causal-link, cross-link, causal diagram/thinking map that show the relationship</td>
<td>1) See Figure 1 [C]</td>
</tr>
<tr>
<td>Semantic Meaning</td>
<td>Sentences/knowledge structure that consist of</td>
<td>1) See Figure 1 [B]</td>
</tr>
</tbody>
</table>
4. Conclusion

By creating a research-based and user-friendly template to incorporate thematic and differentiated instruction into units, this research differentiated instruction as a teaching approach that provides the big picture and broader context of curriculum, teaching methods, students’ outputs of learning, learning resources, and activities involved. Thematic instruction provides in-depth study of a topic by organizing all or parts of instruction around a theme. Overloading of information makes the learners frustrated. Thus, the implementation of thematic instruction that focuses on relevant, rigorous, and condensed content provides sufficient time for students to think critically without focusing on peripheral information. Besides, students normally encounter difficulties in connecting historical events due to the discontinuity of events and people when learning history. Thus, the aim of this study is to assess the value of active construction of thematic information representation in supporting learning and the acquisition of knowledge of historical phenomena in applying an interactive concept map.

References


