Historical Cartoon Semantics Based Learning Support to Enhance Historical Interpretation

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Abstract: In this study, we aim to develop a novel learning support system that imparts a positive learning attitude to learners by having them perform historical interpretation activities in an exploratory way using *historical cartoons as learning materials* that are provided to illustrate historical events. In this paper, we propose a historical interpretation activity support system based on cartoon semantics whereby learners can perform self-exploratory learning in a step-by-step manner according to the historical interpretation process model as well as they are provided with support to encourage their historical interpretation activity according to their interests and learning situations.

Keywords: Historical cartoon semantics, historical interpretation, question generation ontology

1. Introduction

It is important for learners to perform interpretation activities from their own original viewpoints. This not only deepens their knowledge, but also helps to cultivating their logical thinking skills by viewing topics from different angles. In particular, it is recognized that historical consideration skills are important for studying history (Levstik, 1996). Historical consideration is a knowledge-building activity whereby learners develop their own historical interpretations of historical events by thoroughly investigating their surrounding circumstances. Studying such an interpretation requires a learning attitude whereby learners have access to an extensive range of knowledge about historical facts and causal relations. However, ordinary learners find it hard to identify historical viewpoints that can be used to interpret a historical event, and often fall back on rote memorization of historical facts (Spoehr & Spoehr, 1994).

In this paper, we focus on 'historical cartoons' as learning materials to prompt self-directed exploratory learning in order to gain a deep understanding of historical events. Historical cartoons include strong messages conveyed by the cartoonist, who conveys information about the state and behavior of characters in a historical event by imagining what they might be thinking. Our aim is to build a learning environment that uses semantically enhanced historical cartoons to cultivate learning attitudes whereby learners try to understand the background of historical events more deeply and are prompted to develop their own original historical interpretations.

2. Historical Interpretation Activity Support System

2.1 Learning support system for historical interpretation

We have developed a learning support system for historical interpretation activities. Figure 1 shows the interface of our system. The system is designed so that learners can perform historical interpretation activities and then build their own original historical interpretations according to the Kuroda's historical interpretation process model ((i) *Read overall components and their relations*, (ii) *Analyze facts*, and (iii) *Build own interpretation*) that historians use when reading historical artworks (Kuroda, 1986). The system interface comprises following four areas:

Figure 1. System Interface

(A) Cartoon viewing area: This area shows a historical cartoon as learning resource and concept map. The learners examine each object depicted in the cartoon and takes notes on their states and behaviors.

When it is detected that the learner's gaze is fixated on a particular object in the cartoon (the characters and their states and behaviors), the system shows a pop-up window that prompts the learner to think more deeply about the object. Then, the representation object is magnified when the learner gazes at it in more details. The object is also located and visualized in a concept map.

(B) Object consideration area: This area is provided for learners to consider each object and the stakeholder it represents (e.g. a *nation* or *organization*). The learner associates stakeholders with each object by choosing from a list defined by us (authors of the learning materials).

The system judges if the results are adequate, and offers suggestions to reconsider based on the historical cartoon semantics of the learning materials specified by us.

(C) Historical background and thought consideration area: This area is provided for the learners to consider the historical background and the respective stakeholders' thoughts by observing their states or behaviors. It consists of two panels in which they can deepen their thinking about the historical background and thoughts of the stakeholders they wish to consider.

The system includes *historical cartoon semantics* (section 2.2) that convey historical background and thoughts (Fig. 2(II)) and historical viewpoints (Fig. 2(III)). Based on the semantics and question generation framework, this area displays questions that encourage the learner to consider historical backgrounds and thoughts according to the learner's request, e.g., *Let's consider from an international status viewpoint why the Japanese man is depicted with a topknot hairstyle?*

(D) Historical interpretation area: This is where the learners build their original historical interpretations and historical movements by considering the historical background and thoughts gathered in area (C). Learners indicate their historical thoughts, then either choose a pre-prepared historical viewpoint or create their own interpretation of the historical background. Their historical viewpoint appears based on the specifications in the historical cartoon semantics (Fig. 2(III)). They build their original historical interpretation in Fig. 1(D-I) by deepening their historical thought based on the set of historical viewpoints.

When requested, the system asks questions to prompt learners to undertake further historical interpretation with the same mechanism of area (C) (e.g., *Let's consider why Japan wanted to annex the Korean Peninsula by force based on the viewpoint of Japan's domestic economics*). When the learner clicks the arrow button, the statement described moves on to area (D-2), where the learner can deepen his/her historical contemplation by thinking about its significance/impact on subsequent eras.

2.2 Historical Cartoon Semantics and Adaptive Support

It is important that the content of historical cartoons is represented in a way that can be understood by machine understandable way in order to implement adaptive support mechanisms that can grasp the content of a learning context. In our research, we propose the three-layered historical semantics model shown in Fig. 2, which corresponds to the historical interpretation process model (Kuroda, 1986) as the basis of our historical cartoon learning support system. This model comprises
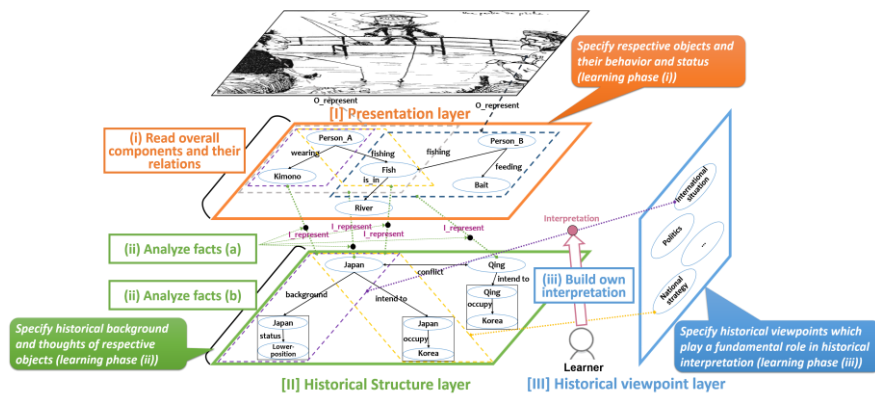
Figure 2. Historical Cartoon Semantics Model

presentation, historical structure and historical viewpoint layers, and can give adaptive support to learners by capturing their historical interpretation model.

In this research, the system (1) focuses on interactions through gaze recognition and semantically enhanced representation objects to capture their interests and (2) gives adaptive questions based on the historical cartoon semantics based question generation mechanism according to their learning processes. Regarding (1), by specifying gaze-aware representation object at the presentation layer, the system can capture part of a learner's interests from his/her eye movements on the cartoon, allowing the system to interact with the learner based on the semantics attached to the target representation object. Regarding (2), by specifying computational semantics according to the historical cartoon semantics model, the system can generate semantics-based questions by using the ontology based question generation framework developed in our previous work (Jouault et al, 2016). More concretely, the system can provide support for historical interpretation activities by giving 'evaluative-type questions' that prompt their inference activities.

On the other hand, one of the things most learners find it hard to understand is the intentions of their instructor when giving evaluative-type questions. To overcome this problem, the system provides evaluative questions with 'historical viewpoints' to be considered, e.g., *Consider why Japan intended to occupy Qing dynasty as part of its national strategy*, based on the historical semantics specified at the historical structure and historical viewpoint layers.

These questions are generated based on the historical cartoon semantics (knowledge base) and evaluative-type question template specified in the question generation ontology. By developing the question generation framework, the system can dynamically generate questions that encourage interpretation activities for various historical cartoons by adding or modifying historical cartoons semantics without having to specify different questions for each individual historical cartoon.

3. Conclusion

In this research, we developed a system that supports historical interpretation activities whereby learners can perform self-exploratory learning in a step-by-step manner based on historical cartoon semantics. Future work is needed to evaluate the proposed system to validate the effectiveness of learners' historical interpretation activities.

References

Jouault, C., Seta, K., & Hayashi, Y. (2016). Content-Dependent Question Generation using LOD for History Learning in Open Learning Space. New Generation *Computing*, *34*(4), 367-394.

Kuroda, H. (1986). *Sugata To Shigusa No Tyuusei-shi*, Heibonsha. [in Japanese].

Levstik, L. (1996). Negotiating the history landscape. *Theory and Research in Social Education*, *24*(4), 393-397.

Spoehr, K. T., & Spoehr, L. W. (1994). Learning to think historically. *Educational Psychologist*, *29*(2), 71-77.