“If Thinking” Support System for Training Historical Thinking

Yuta Miki*, Tomoko Kojiri**, Kazuhisa Seta***

Abstract

Historical thinking is the type of thinking that learns lessons from past historical events and applies them to the modern world. In order to apply lessons, the future situation after the lessons have been applied should be inferred. The future situation has been affected by the causal relationships between people and between properties of the people. In this study, an “if thinking” learning method is introduced so as to understand such causal relationships. In this approach, the change of one historical element is given and its influence on other elements is asked as a question. To answer the question, consider various causal relationships between people and their properties must be considered. In this study, we have also developed a system for presenting “if” situations and judging learners’ answers automatically. The experimental result showed that our system was effective in acquiring causal relationships.

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1. Introduction

Historical thinking is thinking that learns lessons from past historical events and applies them to the modern world. It requires reasoning skill and is regarded as the very essence of historical learning [1, 2]. To accomplish historical thinking, the meaning of historical events, situation changes as a result of historical events, and roles of people involved in the historical events should be observed from more generalized viewpoints. In current historical
learning, however, learners mainly depend on learning by memorization and are not trained to characterize the historical events from specific viewpoints. Of course, some aspects of historical learning, such as memorizing names of people or events, are appropriate for rote learning. Such basic information is necessary for understanding history. On the other hand, such rote study sometimes decreases general motivation to learn. In learning, we usually repeat simple activities many times, for example writing or reading aloud. During such activities, memorization becomes the purpose of the learning, and historical thinking is not trained.

Boxtel et al. [3] and Mayer [4] insisted that fostering the ability to use what was learned to solve new problems is important. Let’s consider an example of applying historical knowledge to a new problem. The debt cancellation order issued by a shogun in the Kamakura era was intended to cancel a samurai’s debt. The samurai’s life became temporarily easier when the order was executed. However, since moneylenders lost their money, they would no longer lend money to the samurai. Thus, the samurai could not borrow money and became poorer than before. According to this historical event, the lesson is acquired: canceling debt by decree will not yield profit. Such a lesson could be applied to current politics; so a method is needed for training historical thinking skill using historical events as knowledge for solving current problems.

Some studies support the fostering of historical thinking skill. Masterman et al. developed a support system for understanding the flow of historical events by mapping causal relationships to a concept map [5]. This study provided only learning materials and environment, but did not support learning itself. Whether learners acquire historical learning skill depends on their abilities. On the other hand, Kojiri et al. developed a system that supports learners in discerning lessons from historical events [6]. They thought important lessons could be seen in several historical events, so they proposed a method for discovering lessons in which learners find common situational changes from two historical events. However, this method did not focus on applying acquired lessons to other situations. As Lee described, it is important to develop the skill of inferring the result of actions based on the results of similar historical events [7]. When applying lessons to the current problem, we should consider the influence of applied lessons on other elements in the current problem. To estimate influence, it is important to grasp the causal relationships between people and properties of people.

This study focuses on understanding causal relationships between people and properties of people. If two properties have causal relationships, the change of one property affects that of the other. For learners to be conscious of causal relationships between people and between properties, we have introduced an “if thinking” approach. The “if thinking” is the application of hypothesis-based inference to the historical learning. This approach is to consider the situation under a given hypothesis: e.g. “If the property of the people is changed to XX” or “If the role of the people is changed to YY.” To consider the properties of other people in the “if” situation, learners have to consider causal relationships between people and their properties. Thus, through this activity, learners may be able to understand causal relationships. We have also developed a system for supporting the learning based on “if thinking.” In this system, the “if” situation is given to the learner and its influence is asked as a question. The system judges the learners’ answers automatically and gives hints to help learners derive the answer successfully.

2. Learning Method for Training Historical Thinking Skill

2.1. Historical events and historical thinking skill

Historical thinking ability is the ability to find problem-solving knowledge from historical events and apply it to a current problem. Problem-solving knowledge is characterized by a bad state, action to solve the bad state, and a good state after the problem has been solved. When we apply historical events to current problems, we implicitly select a historical event whose bad and good states are similar to the current state and expected state. The process of applying historical events is shown in Figure 1. We first abstract bad and good states in the historical events and specialize them. Then, we judge if the historical events can apply to the current problem. Therefore, to acquire historical thinking skill, abstraction of historical events needs to be trained.
Ikejiri et al. proposed a learning method for considering solutions to current problems using historical events [8]. He created a card game that uses cards that represent historical events and the current problem. Learners need to indicate corresponding cards to describe the similarity between the current situation and the historical event. After they find similar historical events, they discuss ways to solve the current problem. This game may be difficult for some learners because they need to abstract historical events and specialize them to the current problem by themselves. Kojiri et al. developed a system that focuses on abstraction of historical events [6]. In the system, two historical events that had the same property changes were shown. Then, learners were led to find the same property changes by transforming the historical events into the property changes and selecting common properties from them. Here, the property corresponds to the state of people that characterizes them. However, even if the pattern of the current problem is the same as the bad situation in the historical event, the future situation is not always the same as the good situation in the historical event, since there are other factors.

In this study, we focus on causal relationships between people. In the real world, the change of one property is propagated to the properties of related people or properties as shown in Figure 2. Such propagation is caused by causal relationships between people or between properties of people. To acquire historical thinking skill, not only abstraction but also understanding of causal relationships should be fostered.

Properties of people change not only because of events but also because of other people’s properties. If people have a causal relationship, the property of one person affects that of the other. There are positive or negative relationships. For people with positive relationships, an increase of one’s property increases the other’s property. On the other hand, for people with negative relationships, increase of one’s property decreases the other’s property. For example, Fudasashi, who is a rice broker in the Edo era, lends money to Gokenin, who works for the shogun. In this case, Fudasashi and Gokenin have a negative relationship because Fudasashi loses money if Gokenin gets money from Fudasashi.
In addition, properties or people are also changed based on the causal relationships between properties. For example, let’s think about the Katanagari event executed by Hideyoshi Toyotomi in the Azuchi-Momoyama era. Katanagari is a policy that prohibits farmers from having weapons in order to prevent them from gaining power. Usually, people who have power tend to establish autonomy. Thus, as a result of Katanagari, the autonomy of farmers has been lost.

2.2. “If thinking” learning method

For the purpose of considering an “if” situation, causal relationships between people and between properties should be understood. Thus, in this study, we propose a learning method for grasping causal relationships by considering property changes effected by another person or property in the “if” situation. We call this learning method the “if thinking” learning method. This learning method consists of four steps.

1. Understanding historical events
   Learners need to understand events, people, people’s properties and the result in historical events.

2. Abstracting historical events
   Knoblock insisted that understanding something is easy by abstracting it [9]. Chang et al. insisted that mapping is efficient for grasping mutual relationships [10]. Hence, to understand causal relationships in general, learners first must abstract historical events. In this study, historical events are abstracted as the sequence of people’s properties that are changed during the actions in the event. Figure 3 is an example of abstracting the historical events about the debt cancellation order issued by the Shogun of Kamakura. In this study, people’s properties in historical events are expressed by “land”, “power” and “money”.

3. Creating “if” situation
   Some properties in abstract form are changed, which means, “Assume that the property has been changed to the particular value.” Usually, a teacher or people who understand the history select an appropriate property by which causal relationships are easy to consider.

4. Considering change of other properties
   Learners think about properties that are affected by the property changed in step 3. To find appropriate properties, learners need to consider the causal relationships between people and between properties. For example, let’s assume that Doso’s land is changed to decreasing from increasing in step 3. Since money and land have a negative relationship, Doso’s money also decreases. In addition, the samurai and Doso have a negative relationship, so the samurai’s land is increasing.

   The property might be influenced by the related factors that are not directly emerged in the given historical events. In the history learning, however, it is common to consider factors only by the given historical events, because the meaning of historical events is different among people or nations. Thus, in this study, only factors that are appeared in the historical events are regarded as related factors.

   ![Figure 3. Change of people’s properties](image_url)
3. “If Thinking” Learning Support System

It is difficult for learners to consider “if” situations by themselves because “if thinking” is a newly proposed learning method in this study, and learners are not trained for it. Furthermore, it is necessary to confirm that learners understand the correct causal relationships. If learners perceive the wrong relationships, this should be modified. To solve these problems, we have developed a support system for the “if thinking” learning method. Figure 4 shows the general structure of the system. This system is composed of an abstraction learning support system and “if thinking” learning support system. The abstraction learning support system focuses on step 2 in the proposed learning method. The “if thinking” learning support system gives an “if” situation as step 3 and supports learners in considering people’s property changes in step 4. Both systems judge the learner’s answer by comparing it and one in the historical events database that contains data related to the historical events to learn. If the answer is wrong, it gives a hint.

3.1. Abstraction learning support system

When the system starts, the window to select the learning theme appears as in Figure 5. The learner selects the desired theme from the list in the form. After the learner selects the theme and pushes the decision button, the system shows a window to make abstraction of the historical event as in Figure 6. In the window, text related to the selected historical event and the area to abstract the historical event are provided. People and sub-events that make up the historical event are shown in the abstraction area. The learner reads the text and clicks a point where he/she thinks a person’s property has been changed by the sub-event. Then, the system shows a window to enter property change as shown in Figure 7. The property change has been inputted by selecting “up” or “down” from the list. Currently, three properties are prepared, such as power, land and money, since these properties often prompt action.

If the hint button is pushed in the abstraction window in Figure 6, the system checks the answer of abstraction created by the learner and shows a hint, if necessary. As a hint, the incorrectly answered point is highlighted by green background color and the sentence that corresponds to the point is emphasized by the red font. If the answer button is pushed, the system compares the learner’s answer and the one in the historical events database and judges whether the learner’s property changes are correct or not.
Figure 5. Start window

Figure 6. Abstraction window

Figure 7. Window for entering property
3.2. “If thinking” learning support system

If a learner created an abstraction of the historical event correctly, the system shows the “if thinking” learning window as shown in Figure 8. The system selects one property from what the learner set in Figure 6 and changes its value. Then, it makes the learner think about properties that become different as a result of another property changed by the system. When the learner clicks a point crossing a person and event, the window to enter a property, which is the same as Figure 7, emerges and the person’s properties are changed.

In Figure 8, if the learner pushes the hint button, the system judges whether he/she described correct or incorrect values of the properties and gives hints if something is incorrect. As the first hint, the system indicates the type of causal relationship for deriving the correct value of property: “Think about a causal relationship between people” or “Think about a causal relationship between properties”. If the learner cannot answer correctly, the system changes the color of the point to change as shown in Figure 8. In addition, if the learner sets the non-related properties’ values, the incorrectly answered point is highlighted by green background color and the system indicates a message: “Think about whether this point has a causal relationship once more”. If the answer button is pushed, the system compares the learner’s answer and the one in the historical events database and judges whether properties have changed correctly. At this time, if the answer is incorrect, the system forces the learner to consider properties to change once more. When the learner derives correct answer, an abstraction form of a new historical event that contains the generated property changes is shown. This new historical event indicates that “if” situation is not “if” but the real historical event. By observing this new historical event, learner is able to understand the cause of the different result of the similar actions.

Figure 8. “If thinking” learning window

4. Experiment

4.1. Method

An experiment was done on 10 university students as subjects. This experiment evaluated whether examinees could acquire the causal relationships between people or between properties. In addition, it also evaluated if exami-
nees were able to use the acquired relationships to solve problems. First, examinees were asked to complete a pre-test. Examinees were able to use information only given by the text. Second, they were asked to use the system. Then, they were asked to complete a post-test, whose questions were the same as those in the pre-test but with different target historical events. Based on these pre- and post-tests, examinees’ understanding of the causal relationships between people and between properties were evaluated. Three historical events were used in the system, the pre- and the post- tests, such as Sino-Japanese War, Tokuseirei of Kamakura shogunate, Kansei reforms. Each events contain 3 to 6 causal relationships.

Table 1 shows questions in the pre- and post-tests. Question 1 asked examinees to describe causal relationships that they detected from a given historical event. This question was used to evaluate whether examinees were conscious of the correct causal relationships. Question 2 showed a problem similar to the historical event given in Question 1 and asked subjects to describe a method for solving the problem. This question evaluated whether examinees could apply knowledge acquired from learned historical events to similar problems: judging whether examinees applied similar action to the problem

| Q1 | List all causal relationships between people or between properties that can be seen in this historical event. In addition, describe the reasons for selecting the relationships. |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q2 | Assume the following situation and answer the question. Your company competed with a rival company to acquire some land and ultimately succeeded. However, during the competition, the rival company used dirty tricks against your company, and your company was badly damaged. So, after the competition, you take action against the rival company. The rival company tries to settle the case out of court and starts negotiation. If you accept the settlement, what would you require from the rival company? Why? |

4.2. Result

In the experiment, while using the system, not all examinees could change properties correctly by themselves, but all examinees chose correct properties after using the hint button. One examinee had difficulty in deriving the causal relationships from the hint, since hints from the system only forces examinees to pay attention to the property where its states should be changed. The examinee could not find whether they needed to focus on relationships between people or between properties. Thus, more definite hints should be necessary so as to make examinees notice the causal relationships to derive the answer.

Table 2 shows the number of causal relationships that examinees detected. The numbers in parenthesis show the number of incorrect causal relationships in all detected relationships. The numbers of detected causal relationships increased from pre-test to post-test for eight examinees, decreased for one examinee and did not change for one examinee. Furthermore, five examinees who described incorrect relationships in the pre-test answered correctly about relationships in the post-test. In the pre-test, examinee D described a relationship only between sub-events and properties, for example, “Sub-event, Tokuseirei, gives samurai the land”. In the post-test, however, the change of property caused by other properties was described, for example “Satisfaction of Japanese decreased by not getting money from Russia, and the nation lost power”. Examinees A, F, G, I and J also gave similar descriptions. This result shows that our system is effective for grasping causal relationships.
Table 2. Number of causal relationships that examinees detected. 
(The numbers in parenthesis show the number of incorrect causal relationships.)

| Examinee | A | B | C | D | E | F | G | H | I | J | Average |
|----------|---|---|---|---|---|---|---|---|---|---|--------|
| Pre-test | 5(1) | 3(1) | 2(0) | 6(1) | 2(1) | 7(0) | 0 | 2(0) | 8(0) | 6(2) | 4.1 |
| Post-test | 7(0) | 2(0) | 4(0) | 7(0) | 3(1) | 13(0) | 3(1) | 3(0) | 8(0) | 7(0) | 5.7 |

The result of question 2 is shown in Table 3. Two examinees who could not apply the method in the historical event to solve the given problem in the pre-test could apply the method in the historical event in the post-test. On the other hand, two other examinees, who could apply methods in the historical events in the pre-test but did not understand the causal relationships, could explain the changes of properties based on the causal relationships in the post-test: “After getting money, the trust of the company was restored.” Two examinees who could not apply the method for solving problems in historical events both in pre-test and post-tests told us that they recognized the method for solving problems in the historical events but decided not to use them because they knew a more effective method. We consider that these examinees have already acquired not only historical-thinking skill but also decision-making skill. According to these results, the “if learning” using the system seems effective for training historical-thinking skill.

| Examinee | A | B | C | D | E | F | G | H | I | J |
|----------|---|---|---|---|---|---|---|---|---|---|
| Pre-test | O | X | O | O | O | X | X | O | X | O |
| Post-test | O | X | O | O | O | X | O | O | O | O |

Finally, the questionnaire results are shown in Table 4. A five-point Likert scale was used for answering the questionnaires. 1 is negative and 5 is positive. Based on the result, many examinees answered that they could understand causal relationships by using the system (question 1). Seven examinees answered that to change properties was difficult (question 2) and felt that the hint from the system was effective (question 3). Three examinees who did not feel that hints were effective insisted that they wanted more concrete advice. Currently, the system only indicates the incorrectly answered points and urges examinees to consider the causal relationships. Further hints should be prepared for examinees who are not able to derive causal relationships only from the hints. According to the result of question 4, many examinees felt that the usability of the system was good.

| Questions                                                                 | Answer |
|---------------------------------------------------------------------------|--------|
| 1. Did you understand the causal relationships?                          | 1 2 3 4 5 |
| 2. Was it difficult to change properties in “if learning”?                | 3 4 0 2 1 |
| 3. Were hints from the system effective?                                 | 0 3 0 4 3 |
| 4. Was the system easy to use?                                           | 0 2 1 3 4 |

5. Conclusion

In this study, we proposed an “if thinking” learning method for training historical thinking and developed a system for supporting the learning. In “if thinking” learning, learners should grasp a historical event from the viewpoint of property changes. Then, they need to understand causal relationships by thinking about how the values of the
property change as a result of the change of other properties. We have evaluated the effectiveness of our “if thinking” learning method based on the learning result using the system. Based on the result, it appears that learning using our system is effective for understanding causal relationships. Moreover, it is effective for training historical-thinking skill, which is the ability to apply problem-solving knowledge in historical events to current problems. However, this experiment was conducted for only 3 historical events. In future, the system needs to be evaluated whether it is effective in other historical events.

We focused on the causal relationships between people and between properties. However, when we consider the effect of applying the method for solving a problem, we often need to consider the events that may occur as a result of the property changes. Such events are important to judge if the applied method were appropriate. Thus, we need to develop a learning method to predict future occurring events.

In the current system, people’s properties are organized by events. In this way, if one property has causal relationships with more than two people or properties, it is difficult to discriminate which causal relationships affect the property. To clarify the causal relationships, we need to update the abstraction window so as to represent relationships between properties clearly.

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