

An Emotional Document Investigation Tool for Academic Writing

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ABSTRACT

One of crucial problems in higher education is the development of learning aids for academic writing. To tackle this problem, we are developing an emotional document investigation tool. In this paper, document investigation is defined as a learner's in-depth reading of an article to find issues from her/his viewpoint. Based on the argument of the function of emotional cognition, we predicted that emotional clues while reading an article should prompt a learner writing an essay to engage in, while considering the issues in the article based on the analysis of the article, and should also result in the learner to use her/his knowledge to argue the issues. Subsequently, we conducted an experiment to examine this prediction, and the results provided support for such a function of emotional clues. Further research should focus on the role of emotional cognition in academic writing.

Author Keywords

Document investigation, Emotion, Annotation on an underlined string

ACM Classification Keywords

H.5.3 [Group and Organization Interfaces]: Evaluation/methodology

INTRODUCTION

Although academic writing is one of the most important topic in higher education, there are no established learning aids in Japanese academic writing education. Watanabe [9] pointed out that most Japanese pupils in elementary schools have not had the opportunity to learn how to write structured, logical and original articles as their work is only superficially evaluated and their teachers give them suggestions on how to improve. Similar problems can also be observed in Japanese junior high schools and high schools. Japanese university students should be provided with opportunities to learn how to write original articles through academic writing education, and attempts to develop a computer-supported

academic writing tool should contribute to academic writing education not only in Japan but in other countries.

Within the realm of the cognitive process of academic writing, our focus in this study is on how learners find issues—in an article—that they can respond to in their writing. In this paper, we define the term *document investigation*. Document investigation is a cognitive process whereby a learner carefully read an article from her/his viewpoint to find issues that (s)he can argue in her/his writing. Document investigation should be one of the most crucial processes in academic writing. Clark and Linn [2] suggested that it encourages learners to generate novel viewpoints and develop a relationship between their knowledge and real phenomena as they gain an in-depth understanding of scientific knowledge by focusing on only one topic. Thus, encouraging learners to engage in document investigation should improve their academic writing activity.

In the process of document investigation, we highlight the role of emotion. Emotional stimulation should facilitate learners' document investigation. Thagard [8] claimed that there should be a strong association between the process of scientific discovery and emotional cognition based on a narrative analysis of scientific discoveries. We suggest an emotional document investigation tool while considering how to stimulate learners' emotion.

RELATED WORK

Annotations on digital documents have been regarded as important technology in information sharing, and recent trends of annotation technology is annotation by users, like folksonomy [1]. According to an analysis of tags in collaborative tagging systems by Golder and Huberman [3], some tags using adjectives have function to represent subjective evaluation of bookmarked Web pages by taggers, and taggers should tend to imitate others' tag usage. In this study, the tag set which represents subjective evaluation is given by the system with the usage, and cannot be added by learners. Then, we examined how such tag set stimulates learners' emotion changes their document investigation process.

Some studies try to utilize subjective annotations. For example, eJournalPlus [7] provides document annotation and analysis environment by adding annotations to an underlined string with some colors and forms. However, such colors and forms hitherto have no meaning in the system. Addi-

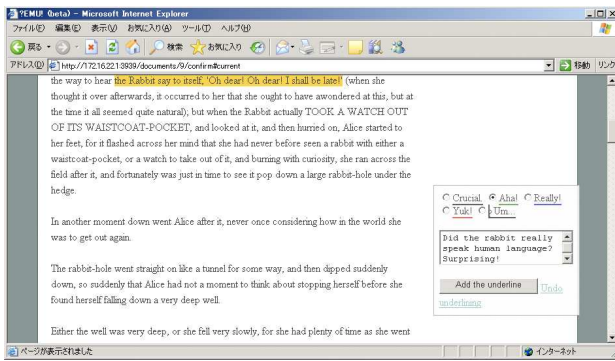


Figure 1. Adding an underline to an article on the EMU system

tionally, Ito et al. [5] attempted to evaluate an avatar-based subjective annotation system. In this system, a user could add an avatar on information representing emotional expression by its body. Ito et al.'s evaluation focused on the longitudinal consistency of meanings of a subjective annotation in an individual user and among users. However, they did not discuss how such subjective annotation changes a user's thoughts. In this study, we develop the EMU (Emotional and Motivational Underliner) system, which attempts to add meanings to the colors of the underline that represents a certain emotion to stimulate a learner's emotion in the document investigation process.

IMPLEMENTATION OF THE EMU

Based on the argument above, we expect that users can acquire the skill of finding and sophisticating problems for academic writing through emotional document investigation. The EMU consists of two main functions that will be evaluated in this paper. First, a user can leave annotations for an arbitrary string in the articles registered on the EMU system. Second, the user can add an emotional tag for each annotation. In this article, we focus on these functions regarding to emotional document investigation.

When a user leaves an annotation for an arbitrary string of the articles registered on the EMU system, the user must add an emotional tag to the string from a tag set provided by the system. The tag set consists of the following five tags with the following usage descriptions:

Crucial. Choose this when you want to say "This part is crucial."

Really! Choose this when you want to say "Really, that's right," or "Good!"

Aha! Choose this when you want to say "I haven't realized this," or "It's great!"

Yuk! Choose this when you want to say "Hey, that's wrong," or "It's awful!"

Um... Choose this when you want to say "You bet?" or "I don't get it."

The tag and description set above contains casual expressions in order to induce the user to respond to the article in an emotional manner. The user can add a comment to the string, that is, underlining a string without comments is also allowed.

The EMU system was implemented as a Web-based content management system using Ruby on Rails 2.0.2. The annotation interface, as shown in Figure 1, was implemented with JavaScript so that the user could use the EMU system only with a Web browser.

EXPERIMENT

We conducted an experiment to examine the influence of emotional tags in document investigation by the learner.

Participants

Fifty-four Japanese undergraduate students participated in the experiment. All the experimental instructions and materials were provided in Japanese. The experiment was conducted during a course on educational studies. The participants were randomly assigned to one of the three conditions explained below.

Design

The experiment had with one three-level independent variable (between-participant variable). Each level of the independent variable was defined in the following group:

One-color group (1C; $n = 18$) The participants in this group were told to underline and leave a comment in an article given by the experimenter with one color as they would usually underline and annotate paper handouts and books.

Five-color (rational) group (5CR; $n = 18$) The participants in this group were told to underline and leave a comment in an article with this tag and description set, instead of the tag set explained above:

Important Choose this when you think that this part is important (substitute for *Crucial*).

I agree Choose this when you think that you can agree with this part (substitute for *Really!*).

I did not know Choose this when you think that you did not know about this part (substitute for *Aha!*).

I disagree Choose this when you think that you cannot agree with this part (substitute for *Yuk!*).

I cannot understand Choose this when you think that you cannot understand this part well (substitute for *Um...*).

We prepared these tag sets so that they have equivalent meanings to the original tag set and also to induce the user to rationally analyze an article.

Five-color (emotional) group (5CE; $n = 18$) The participants in this group were told to underline and leave a comment in an article using the tag and description set explained in the previous section.

The experimental procedure was the same among these groups with the exception of the these definitions of the tag sets.

Table 1. Mean and SD of data of the annotations on the article

	Number of the underlines		Length of the comments	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
1C group	11.89	5.41	103.83	92.01
5CR group	13.06	4.61	157.78	87.04
5CE group	11.22	3.28	167.16	110.61

Table 2. Number of underlines with/without comments

	Without comments		With comments	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
1C group			128	86
5CR group			95	140
5CE group			81	121

Procedure

Each participant was told that (s)he should write an essay supporting or opposing an opinion expressed in the given article. First, (s)he answered a preliminary questionnaire about his/her use of annotations in the case of paper handouts and her/his own books. Second, (s)he tried to get accustomed with the annotation interface of the EMU system by working on a trial document. Third, (s)he read the article supporting increase in the gap between the rich and the poor [4]. Although the original article pointed out some flaws in the argument supporting the increase in the gap between the rich and the poor, this part was omitted during the experiment in order to observe how the participants could identify such flaws. Next, the participants had to add underlines and comments to the document according to the tag and description set whose definition depended on the experimental group that (s)he belonged to. Then, after performing these tasks (s)he wrote an essay based on the reading of the article. Finally, the participant was debriefed (the original article of Harlan [4] was presented) and thanked.

Measures

We adopted the following measures observed during the experiment:

Number of the underlines We counted the number of the underlines made by each participant.

Length of the comments We counted the number of characters in the comments added to each underline.

Evaluation scores of the essay Two of the authors independently and heuristically evaluated the essay written by the participants by using a 5-point scale (1: poor – 5: excellent). The evaluation was based on the following criteria: whether the participant tried to analyze the issues in the article, and whether (s)he tried to argue the issues using facts not mentioned in the article. We used the average score between the two authors as the evaluation score. Pearson's product-moment correlation indicated a high correlation between two scores of the two authors ($r = .85, p < .001$).

Results

Data of annotations on the article

Table 3. Mean and SD of data about annotations on the article categorized by tags

	Number of the underlines		Length of the comments	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
<i>Important</i> (5CR)	4.11	3.61	29.28	38.91
vs. <i>Crucial</i> . (5CE)	2.33	2.11	14.94	24.47
<i>I agree</i> (5CR)	3.11	1.78	40.28	30.76
vs. <i>Really!</i> (5CE)	1.17	1.34	15.17	29.36
<i>I did not know</i> (5CR)	2.83	1.47	24.50	36.57
vs. <i>Aha!</i> (5CE)	3.44	1.98	33.39	42.73
<i>I disagree</i> (5CR)	1.78	1.73	42.00	52.95
vs. <i>Yuk!</i> (5CE)	1.72	1.41	37.67	36.80
<i>I cannot understand</i> (5CR)	1.22	1.69	21.72	27.34
vs. <i>Um...</i> (5CE)	2.56	2.01	66.00	64.70

Table 1 shows the mean and SD of data on the number of underlines and the length of comments. There seems to be hardly any differences in the number of the underlines between the groups. The result of the one-way ANOVA indicated that there were no significant main effects ($F(2, 51) = 0.76, p = .47$). The lengths of the comments by 1C group participant seem shorter than those of the other groups. Nevertheless, the one-way ANOVA indicated that there were no significant main effects ($F(2, 51) = 2.23, p = .12$).

Table 2 indicates the number of underlines with or without comments. This result shows that participants in the 1C group added underlines to the article without comments more than the other groups. The chi-square test indicated there were significant differences among the cells ($\chi^2(2) = 22.04, p < .001$). The residual analysis in the cells of the numbers of the underlines without comments indicated that the participants in the 1C group added the underlines without comments significantly more than those with comments ($z = 4.69, p < .001$), while those in the 5CR group ($z = -2.41, p < .05$) and the 5CE group ($z = -2.26, p < .05$) added the underlines without comments significantly less than those with comments.

Table 3 shows the mean and SD of data on annotations in the 5CR and 5CE groups categorized by tags. Comparing the data between the two groups for each tag, the participants in the 5CR group tended to use the *Important* tag and the *I agree* tag more than their counterparts in the 5CE group. In contrast, the participants in the 5CE group tended to use the *Aha!* tag and the *Um...* tag more than their counterparts in the 5CR group. We examined the difference in the tendency of tag use between the 5CR group and 5CE group by a two-way ANOVA (split-plot design: the independent variables were groups as the between-participant variable and tags as the within-participant variable) for the number of underlines and the length of comments. The analysis indicated that the interaction between groups and tags ($F(4, 136) = 4.46, p < .01$) were significant when considering the mean of the number of underlines. Then, we conducted a simple main effect analysis for each tag and the analysis showed a simple main effect of *Important/Crucial*. ($p < .01$), *I agree/Really!* ($p < .001$), and *I cannot understand/Um...* ($p < .05$). Also, there was a significant interaction between groups and tags

($F(4, 136) = 4.24, p < .01$) when considering the mean of the length of comments. Similarly, the simple main effect analysis for each tag was conducted, and the analysis showed a simple main effect of *I agree/Really!* ($p < .05$), and *I cannot understand/Um...* ($p < .001$).

Evaluation scores of the essay

The participants in the 5CE group obtained the highest essay scores ($M = 3.97, SD = 0.96$), followed by the participants in the 1C group ($M = 3.33, SD = 1.25$). The participants in the 5CR group obtained the lowest scores ($M = 2.58, SD = 1.43$). A one-way ANOVA indicated that the main effect of group was significant ($F(2, 51) = 5.77, p < .01$), and multiple comparisons using the Holm method indicated that there was a significant difference in the essay score between the 5CE and 5CR groups ($p < .01$). No significant differences in essay scores were not observed between the 5CE and 1C group ($p = .15$) or between the 1C and 5CR groups ($p = .15$).

Discussion

Although there was no difference in the number of underlines and the length of the comments among the three groups, the percentage of underlines without comments by the participants in the 1C group was higher than that by the participants in the other groups. This result implies that the tag and description sets generated by the system in the 5CR and 5CE groups function as a scaffold for generating comments. In fact, the result of the preliminary questionnaire indicates that most participants use annotations on paper documents to indicate important strings and to complement information from lecturers rather than to note down their own thought. Thus, the tag and description sets should give the participants clues to generate comments on each underline.

The difference between a seemingly rational tag set for the 5CR group and a seemingly emotional tag set for the 5CE group should appear in writing process. The participants in the 5CE group tended to write the essay by finding issues from the article and utilizing their knowledge in writing the essay to argue the issues. This result suggests that the seemingly emotional tag set encouraged the participant to relate issues from the article to her/his knowledge. As Thagard [8] pointed out, emotion should play an important role in problem discovery. Thus, the emotion of a learner stimulated by the tag set should prompt the learner to find issues from the article and connecting these issues to her/his knowledge.

Nevertheless, there are problems with the analyses in this paper. We did not refer to the content of the comments on each underline and the essay. The content-based association between the comments and the essay should be examined to determine the detailed process of document investigation. Moreover, it would be inadequate to write an essay with a well-formed structure and logic solely based on emotion. Thus, the role of collaboration should be focused on because the collaboration between learners can help the elaborate of learners' knowledge base [6]. We have already implemented the function of collaboration by encouraging learners to share annotations with each other and adding

comments on annotations by other learners. An evaluation of this function should be conducted in an academic writing class for undergraduate students, where the discussion should focus on whether and how such collaboration can enhance learners' comments and essays.

CONCLUSION

We are developing the emotional document investigation tool by annotating tags and comments on arbitrary strings in an article. Then, we conducted the experiment to examine how the emotional tag and description set induced the learner to read the article skeptically, find issues from her/his viewpoint, and bring her/his own knowledge in her/his essay. Detailed content-based analysis of the experimental results and the evaluation of the collaborative function should be conducted in the future. Through the development of the document investigation tool, the important role of emotional cognition in academic writing should be discovered.

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