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The effect of the ratio of text and images in comics on learning effects

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Abstract This study analyzes the influence of the ratio of text and images in comics on learning effects. In this research's comparative experiment, we set up comic textbooks with text and image ratios of 1:1, 0.7:1, and 0.5:1, respectively. We summarize and analyze the test results obtained by letting students learn comic textbooks with different ratios. It concludes that the learning effect of using comic textbooks with low text coverage is positively related to the degree of love for comics, while there is no apparent relationship when using comic textbooks with high text coverage. On the other hand, regardless of the ratio of textbooks used, students pay more attention to the reading text than images when they have a stress test, and this phenomenon is more evident in students who use comic textbooks with low text coverage.

Keywords comics, data science education

1 Introduction

Before this, there have been many experiments showing that comics can strengthen students' enthusiasm for learning and improve learning effects. Okubo established the three-layer comic reading comprehension model, which includes surface form, text-base, and situation model. He analyzed the relationship between working memory and the 3-layer model and found that comics and articles' comprehension is positively correlated, especially at the text-base level[2]. Tamada divides comics into verbal comics and verbal-image combined comics and divides the strategies for reading comics into verbal-oriented strategies and image-oriented strategies. Through experiments, it shows that when students are studying in class or self-studying outside of class, no matter which kind of comic textbook is used, the reading strategy is flexible, and there is no apparent definite relationship[3]. Based on the above research, it shows that the use of different comic textbooks will have

learning effects, and the influencing factors are also different. Based on Tamada's comic classification method, we have explored the different effects of different verbal-oriented comics at the surface form level and found that comic comprehension is related to the learning effect of comics textbooks. Students with high comic comprehension performed better in the test, and they were more willing to use comic textbooks. At the same time, it was found in the experiment that the ratio of text and images in comics has a significant impact on the learning effect.

This research is based on the above conclusions and further analyzes the influence of different comic textbooks on the learning effect at the text-base level. In the experiment, comic textbooks with text and image ratios of 1:1, 0.7:1, and 0.5:1 were set, and test questions were set to explore the impact of text and image ratios on comic textbooks' learning effect by comparing the test results of different comics textbooks.

different

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2 Experiment

In this experiment, we set up three comic textbooks with text and image ratios of 1:1, 0.7:1, and 0.5:1, respectively. The textbook's content is about "correlation coefficient," and three groups of students use these three types of the comic textbook, which records as Group 100%, Group 70%, and Group 50%, indicating the text's percentage remained in the comics. Students in each group study the corresponding comic textbooks and complete tests and questionnaires. According to the test scores and the questionnaires' results, we analyze the impact of the ratio of text and images in comic textbooks on the learning effect.

2.1 Subjects

15 Students are divided into three groups: Group 100%, Group 70%, and Group 50%. The students were all adult college students (regardless of gender), had a mathematical foundation, and were all non-statistics majors.

2.2 Materials

(1) Comic textbooks

In the experiment, the statistics comic textbook "Learn Statistics-through Comics"[4] was selected in which the ratio of text and images in the textbook was close to 1:1. Keep 100%, 70%, and 50% of the text in the comic textbook, and the corresponding text and image ratios are 1:1, 0.7:1, 1:0.5, respectively.

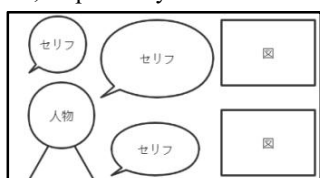


Figure 1. 1:1 comic textbook

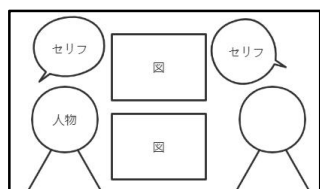


Figure 2. 0.7:1 comic textbook

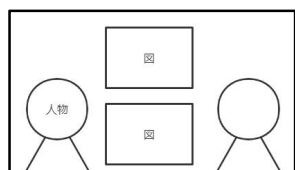


Figure 3. 0.5:1 comic textbook

(2) Test

The test questions are about the "correlation coefficient" and remain the same in all groups.

(3) Evaluation

The comics attitude evaluation: Ask the students how they like comics in 5 levels. (5: very like; 4: like; 3: whatever; 2: dislike; 1: very hate) The GPA evaluation: Ask the students about their academic performance.

(4) Questionnaire

The questionnaire is set up to ask students their views on different comic textbooks and their strategies for using comics. There are 8 questions including what kind of comics textbooks they would like to use and what strategy (verbal-oriented strategies and image-oriented strategies) they choose when reading comics textbooks.

2.3 Steps

Divide students into three groups and record them as Group 100%, Group 70%, and Group 50%; Let students read different comic textbooks and learn the content of correlation coefficients; Ask students to test the correlation coefficient and answer the evaluation form and questionnaire.

2.4 Results

ANOVA was performed for each group's test scores, attitudes toward comics, and GPA. As a result, there is no significant main effect, interaction, and significant difference in each group's experimental results.

The results of the test and evaluation form are shown in Tables 1, 2, and 3. And the correlations between test scores of each group, comics attitude, and GPA are shown in Table 4.

Table 1 Test results

test[0;8]	Group 100%	Group 70%	Group 50%
n	5	5	5
M	5.8	6.4	6.6
SD	0.748	0.748	0.748

Table 2 Evaluation results

attitude[1;5]	Group 100%	Group 70%	Group 50%
n	5	5	5
M	3.8	4	3.8
SD	0.748	1.095	0.748

Table 3 GPA results

GPA[1:4]	Group 100%	Group 70%	Group 50%
n	5	5	5
M	3	3.2	3.4
SD	0.632	0.400	0.490

Table 4 The correlation between test scores and others

Correlation	Comic attitude	GPA
Group 100%	-0.071	-0.423
Group 70%	0.373	-0.408
Group 50%	0.327	0.666
All	0.170	0.036

3 Discussion

3.1 The effect of text and image ratios in comics on learning effect

According to the experimental results in Table 1, the Group 50% has the best test results, and the Group 100% has the worst results. The reason may be that in the Group 100%, according to the cognitive load theory[4], students need to concentrate on reading a large amount of text in a short time, which has high requirements for their learning ability. But, in the Group 50%, the text was cut a lot, leaving only the most concise parts. The students were able to grasp the most crucial information quickly, so the test score was the Group 50%.

3.2 The influence of comics attitude and academic performance on the learning effect of different manga textbooks

According to Table 4, the learning effect of comic books is positively correlated with the comics attitude, the degree of fondness for comics but has almost no correlation with academic performance. From the perspective of each group, in the Group 100%, the learning effect and the comics attitude are almost not correlated, in the Group 70% and 50%, the learning effect and the comics attitude are positively correlated, and in the Group 50%, academic performance and learning effect are also positively correlated. The results show that the degree of fondness for comics will affect the learning effect of using comics textbooks. Students who love comics more perform better in using comics textbooks and are more willing to use comics textbooks. This point also validates the hypotheses about manga comprehension and manga attitude in previous studies[2].

3.3 The reading strategies used in different comic textbooks

A questionnaire with eight questions was set up in the experiment. According to the results, in terms of reading comics strategies, as a whole, no matter which group of students they are, they pay more attention to the text when there is a stress test and the results are shows in Figure 4. Moreover, this phenomenon is the most prominent in the Group 50% with the least text retention rate. Nearly 100% of the students chose the verbal-oriented strategy, while in Group 100%, 40% of the students chose image-oriented strategy. In Group 70%, 20% of the students chose image-oriented strategy. It may be because in textbooks with less text coverage, students have to focus on text to get the most information about knowledge, and the storyline of comics is not over-interpreted, and in the Group 100% with the highest text retention rate, Students can obtain information based on images or text, so they are more flexible in reading strategies. The results of Group 70% also proved that the lower the text's coverage, the higher the proportion of students who choose the verbal-oriented strategy.

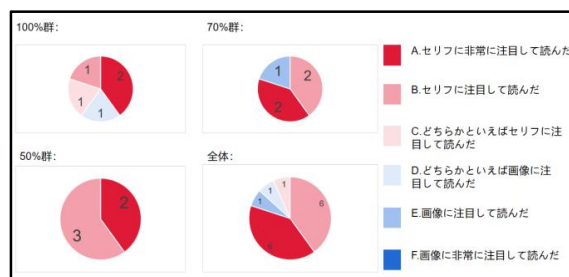


Figure.4 the results of the questionnaire

In the questionnaire, we set up two scenarios: in class and after class, to examine students' views on text and image ratios. According to the survey results, after class, in the self-study scene, most students agree that the proportion of text in comics is greater than 70% or less than 30% will harm the learning effect. In class, when a teacher explains, most students believe that the text ratio is greater than 70% will harm the learning effect, while only half of the students believe that the text ratio is less than 30% will have negative effect influences. Students need to pay special attention to the text part to obtain knowledge and information in the self-study scenario, so too little text ratio is not conducive to obtaining vital information. In the scene where a teacher explains, some

students think there is no need to have too many texts in the textbook, and even no texts are needed to obtain information.

If we discuss each group separately, due to the anchor effect's impact, most Group 100% students believe that the text ratio greater than 70% will have a negative impact. More students Group 50% believed that the proportion of texts greater than 30% would negatively impact the learning effect.

4 Conclusion

In this experiment, three kinds of comics with different text and image ratios were set up, and the learning effect of comics with different text and image ratios was obtained through the test. According to the experimental results, when the text and image ratio is 0.5:1, it has the best results. Besides, the degree of fondness for comics will also affect the learning effect of using comics textbooks. Students who love comics perform better in the test and are more willing to use comics textbooks instead of using different comic textbook ratios. There is no significant correlation between academic performance and the learning effect of using comic books. In the two strategies for reading comics, the verbal-oriented strategy and the image-oriented strategy, the lower the text retention rate, the more students choose the verbal-oriented strategy. When the ratio of text and image is 1:1, students have more flexibility in choosing reading strategies. Which strategy to choose depends on the students themselves and has no significant relationship with textbooks. Most students think that the proportion of texts exceeding 70% or less than 30% will harm the learning effect, and the answers of the students in each group are also different due to the impact of the anchor effect. The result is closer to the proportion of comics read in the experiment.

5 Future work

This experiment studies the influence of text and image ratio in comics on comic textbooks' learning effect. This study sets up three different comic textbooks by retaining the text in comics in different proportions and ignoring text content when removing text. In actual comic textbooks, the text can be divided into story text and explanatory text. The story text includes the comics' lines to narrate the story, promote the plot of the story, and the dialogue between the characters about the comic

story. The explanatory text includes the text that explains knowledge, the text that connects the knowledge plate, and the text that guides the knowledge plate's reading. In the follow-up research, we will focus on the impact of the type of text on comic books' learning effect and compare the different effects of story text and explanatory text on learning.

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