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Analysis of Basic Characteristics of Presented Instructional Materials and Study of Factors of Comprehension

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Abstract: In this research, we investigate the impact of the timing of associated oral explanations and the volume of textual information contained within teaching materials by blackboard- and slide-based presentations. We made comparative tests under varying conditions of both (a) amount of textual information and (b) the timing oral explanation, either with visual presentation or after it. Our results suggest that synchronous explanations, characteristic of blackboard-based presentations, have a positive impact on comprehension. We also experimentally reveal that the use of highly detailed presentations and explanations to solidify some point do not necessarily aid the learners' comprehension of that point. It is our hope that these findings will provide a foundation for further study of methods of presenting instructional materials.

Keywords: instructional material presentation, presentation analysis, blackboards, slides, oral explanations

1. Introduction

In earlier research, we have experimentally explored the similarities and differences among (a) dynamic presentation by means of a blackboard (i.e., advancing the presentation by writing at the time of presentation) or slides (i.e., by making use of some animation capability) and (b) static presentation (i.e., simply presenting a final result) (Okazaki, Noguchi & Yoshikawa, 2014; Okazaki & Yoshikawa, 2017).

In this research, we experimentally explore issues related to the timing of associated oral explanations along with the textual volume of the material, and assess the impact of such factors on learner comprehension. By revealing the characteristics of instructional material presentations in terms of their visual aspects, the audial aspects, and interactions between the two, we seek to gain a basic understanding of blackboard- and slide-based presentations.

2. Experiment: Instructional Material Presentation Under Differing Presentation Factors

In this experiment, we compare post-instruction test scores and subjective opinions of participants under cases of (a) a synchronous (simultaneous) presentation and explanation of instructional materials, (b) an audial explanation following a presentation of instructional materials, and (c) differing amounts of textual presentation.

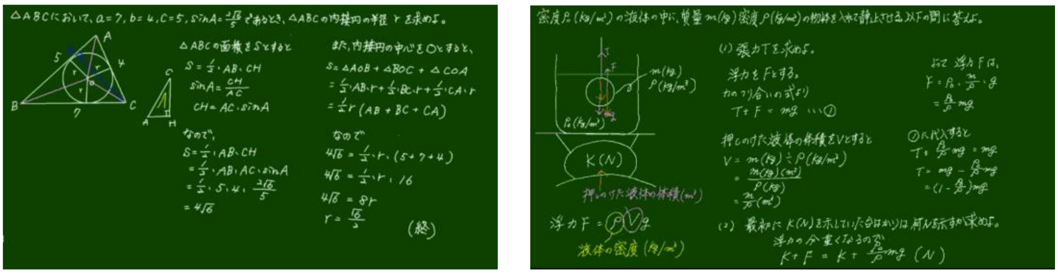
2.1 Experimental method

Testing was conducted on two days (January 17 and 18, 2018). Eighteen students within the Faculty of Science and Engineering at Saga University participated in the experiment. Each testing period lasted approximately 45 min. Two lectures were given, one relating to inscribed circles (geometry) and the other to buoyancy (physics). Instructional materials were prepared and presented as follows. One set of materials was entirely written, containing both equations and explanations. Another set omitted some of these equations and explanations. This gave us a total of 4 sets (2 sets × 2 subjects). We varied the timing of the presentation and explanation into two patterns for each of these materials sets: one in which the presentation and explanation were given simultaneously, and one in which the explanation followed the presentation. This created 8 distinct lectures.

Oral explanations were the same across introductions sets. We used Handwriting Presentation Tool (HPT), an application developed within our research group (Hosoki et al., 2011), to create handwritten parts of lectures. For audio recording, we used Audacity, a free software package that can edit waveforms. We used Movavi Video Suite to combine visual and audio components. Figures 1 (a),(b) show the lecture of entirely written version.

Our test procedure is as follows. After the presentation of one lecture, participants were asked to solve a problem similar to those presented and complete a questionnaire. They repeat this process twice. After both lectures, they were asked to complete a more general questionnaire.

Participants were arranged into four groups. Groups 1 and 4 had five members each; Groups 2 and 3 had four members each.



(a) Geometry (b) Physics

Figure 1. Instructional materials for the experiment (Entirely written version).

Table 1: Average scores of post-instruction tests for each lecture by group (100 point scale).

	Geometry	Geometry (ignore calculation errors)	Physics	Physics (ignore calculation errors)
Group1	85	100	60	64
Group2	56	56	45	45
Group3	38	56	35	55
Group4	65	80	32	48
Total	63	75	44	54

	Synchronous + Entire		Non-Synchronous + Entire
	Synchronous + Omitted		Non-Synchronous + Omitted

Table 2: Responses to the subjective questionnaires (The lecture is clearly explained).

	Strongly agree	Agree	Disagree	Strongly disagree
Geometry : Entirely written	34%	33%	22%	11%
Geometry : Partially omitted	45%	22%	33%	0%
Physics : Entirely written	33%	45%	22%	0%
Physics : Partially omitted	11%	56%	22%	11%

2.2 Experiment results

Table 1 shows the average results for each lecture by group. In the table, “Synchronous” and “Non-Synchronous” indicate the timing of oral explanation; “Entire” and “Omitted” indicate the amount of text.

To analyze the impact of the timing of the oral explanation on comprehension, we compared the following pairs: in geometry, Group 1 against Group 3 and Group 2 against Group 4; in physics, Group 1 against Group 2 and Group 3 against Group 4. This showed a tendency for better scores when instructional materials and audio explanations were presented simultaneously.

To analyze the impact of the volume of information presented, we compared the following pairs: in geometry, Group 1 against Group 2 and Group 3 against Group 4; in physics, Group 3 against Group 1 and Group 4 against Group 2. This showed a tendency for better scores when some information was omitted.

In this experiment, the omitted information was a formula simplification. Without it, students made fewer errors when rewriting the formula themselves.

Table 2 shows the responses to the subjective questionnaires.

Little difference was seen in comprehension between lectures. Group 2, who received simultaneous explanations and presentations first, followed by non-simultaneous explanations and presentations, subjectively judged the simultaneous version as better. Group 3, who received the reversed order, agreed. This shows the synchronous approach is subjectively preferred.

In the last general questionnaire, nearly all respondents (94%) thought oral explanation was necessary, stating that it is otherwise hard to understand the purpose of graphs and that receiving information in two ways (i.e., seeing and hearing) is helpful.

3. Conclusion

In this research, we examined two commonly employed methods of presenting instructional materials, blackboard- and slide-based presentations. We tested participants in an experiment, exploring the impact of the sequencing of visual presentation and oral explanation (either together or visual followed by oral) and the amount of text within the instructional material. Our results suggest, first, that presenting and explaining at the same time may be more effective than presenting first and, second, that increasing the amount of information does not necessarily improve comprehension.

The number of participants was low, and we examined only a limited set of instructional materials and lecture types. For future research, it would be useful to investigate different instructional materials to confirm our findings and recruit enough participants to permit full statistical analysis of outcomes. We note that we did not vary the amount of orally presented material, and testing the effect of various amounts also warrants further study.

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