Final Report--- ------ Jue Wang, Evgenia Daskalou

Introduction

Theoretical background

Our experiment was generated by **Cognitive load theory**, which describes learning structures in terms of an information processing system involving long term memory, which effectively stores all of our knowledge and skills on a more-or-less permanent basis and working memory, which performs the intellectual tasks associated with consciousness. Information may only be stored in long term memory after first being attended to, and processed by working memory. Working memory, however, is extremely limited in both capacity and duration. These limitations will, under some conditions, impede learning. (Sweller, Cooper)

The fundamental tenet of cognitive load theory is that the quality of instructional design will be raised if greater consideration is given to the role and limitations of **working memory.** Thus, two separate sources of **cognitive load** should be taken into consideration (Leahy, Chandler and Sweller):

- **Intrinsic cognitive load**, which is related to the difficulty of concepts, and is determined by the intellectual demands or complexity of the learning material;
- While **extrinsic cognitive load** is due to the design of the instructional materials, and is determined by instructional design or activities required of the learner and so are under the control of instructors. In inefficient instructional designs it adds unnecessary load.

In general, Sweller thinks that instructional techniques should attempt to reduce extraneous cognitive load associated with constructing a representation because this facilitates learning. According to Rebetez (2006:12-13) Sweller, based on his cognitive load theory, describes a series of effects and guidelines to create learning materials including the split-attention effect, the modality effect, the redundancy effect, etc.

- **Split-attention** effect occurs when learners have to process and integrate multiple and separated sources of information.
- **Modality effect** implies that the amount of information that can be processed using both auditory and visual channels may be larger than that of a single channel. Research suggests that more memory capacity is available when dual modalities were used, however it may lead to a split-attention effect and excessive animated multimedia may lead to a general overload.
- **Redundancy effect** occurs when the same information is presented more than once. The multiple processing is negative for comprehension since it increases external cognitive load.

Clark and Mayer (2003) have summarized empirical evidence that graphics explained by audio alone helps to achieve better learning results than graphics explained by audio and redundant onscreen text since the former helps to avoid overloading the visual channel of working memory. However, there are also certain situations that benefit from the redundancy of the on-screen text.

In this experiment, we intent to compare the learning results of the graphics explained by audio text alone and the one explained by both audio and text. Thus we intent to test the hypothesis that complicated multimedia presentation of graphics explained by both audio and onscreen text can help or impede learning.

General Hypothesis

In this research, we want to compare the participants' performance on audio/visual presentation of the learning material and audio/visual with supplementary text presentation of the learning material. We want to see what kind of influence the redundancy of the audio text will have on the participants' learning performance.

Methodology

Participants

10 university students (4 bachelors and 6 masters) divided into two groups participated in our study; each group contains 2 bachelors and 3 masters.

Variables

VI:

VI 1. two conditions of the presentation of the testing materials (an animations about the formation of oceans and mountains), one is audio/visual without text, the other is audio/visual with extra on-screen text.

VI 2. the participants level (bachelor or master students)

VD:

VD 1 the test score of each participant varying from 0 to 12.

VD 2 the time the participants have spent doing the test (vary from 5 to 15 minutes)

Controlled variables:

- the participants' previous knowledge of the formation of oceans and mountains (there should be no expert in this domain)
- the age of the participants (only young people: aging 20-30)
- all participants speak French well enough to understand the content of the material

Material

1. An animation of the formation of oceans and mountains presented in two different ways: one is audio/visual and the other is audio/visual with supplementary onscreen text of the audio content.
2. The questionnaire is composed of 12 questions about the testing material, plus 5 questions about the participants' background.

Procedure

1. Before experiment: the participants were informed of the task and were randomly allocated to one of the instructional groups.
2. Stage 1. Instruction stage:
    - Group 1 will be presented with the audio/visual material while Group 2 with the audio/visual material with extra onscreen text, twice.
    - The experiment should be under the supervision of the experimenter
    - The participants are not allowed to push any button on the screen
    - The participants are not allowed to discuss during this stage

3. Stage 2. Testing stage:

    - Each participant will be asked to answer 12 questions concerning the comprehension of the formation of oceans and mountains.
    - The test will be marked out of 12 (one mark for correct answer, no marks for incorrect answer), no time limit.
    - The time spent answering the questions will be recorded.
    - The participants are not allowed either to refer to the animation or to go back to the questions when they finish each of them.
    - Discussion is not allowed during the test

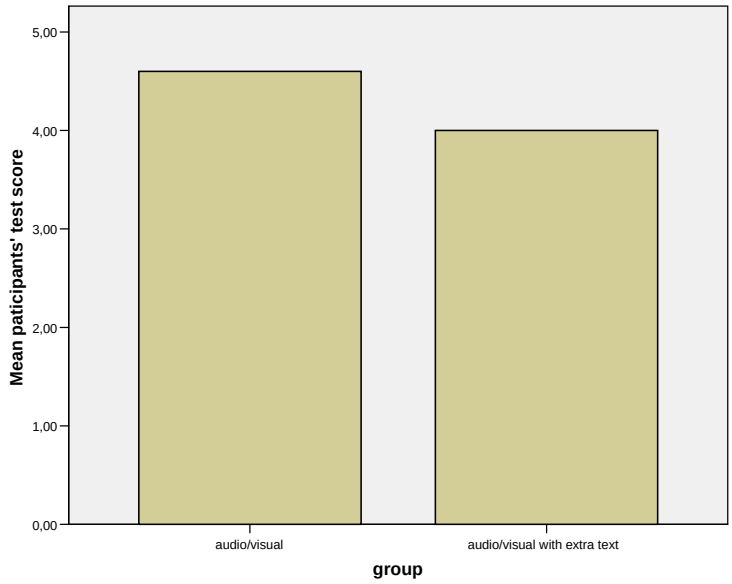
Operational Hypotheses

1. The audio/visual only group performs better than the audio/visual with text group since the former does not have much working load during the learning process.
2. There might be a difference of the scores between bachelor and master participants. We hypothesize that master participants score higher than bachelor participants.
3. Interaction hypothesis will be:
    - Master participants with audio/visual only will score higher than bachelor participants with audio/only
    - Master participants with audio/visual-text will score lower than bachelor participants with audio/visual-text

Statistical Analysis of the Result

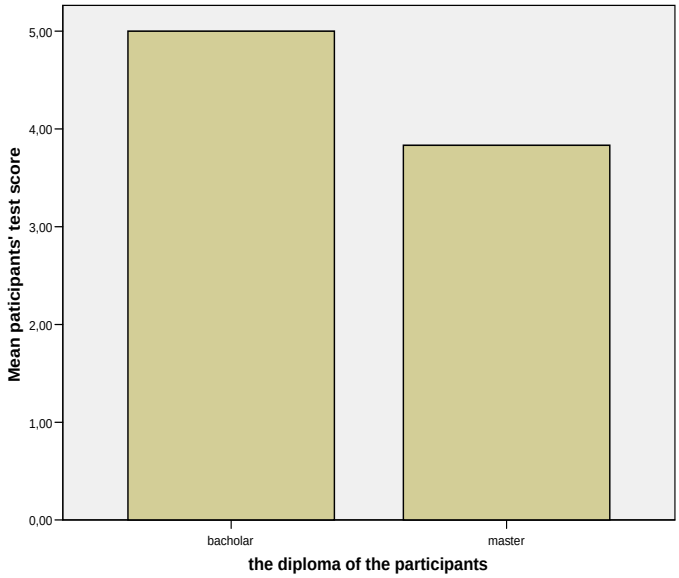
The data of the testing result was put into an SPSS file and was analyzed descriptively together with ANOVA.

Graph 1 *the comparison of the score of the participants in correlation with the group*



From Graph 1 we see that the audio/visual-without-text group score higher than the audio/visual-with-text group, which is in accordance with our first hypothesis, but this difference is not significant ($F(1;6)=0.662$, ns). So this result cannot be used to support our first hypothesis.

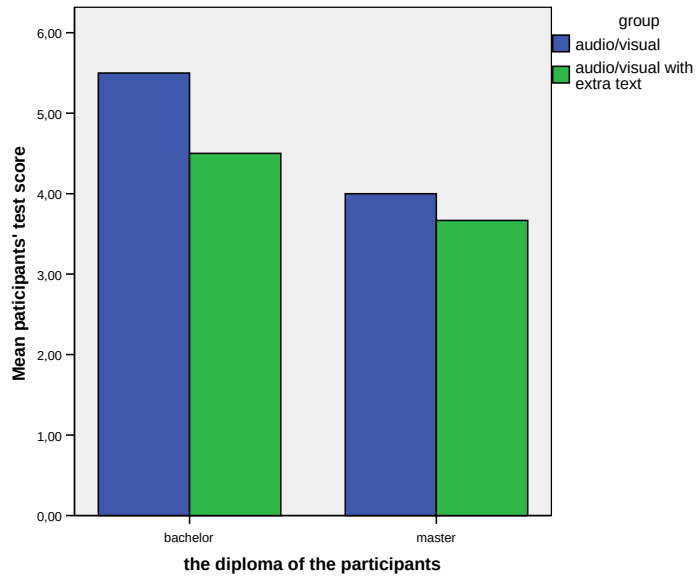
Graph 2 *the comparison of the score of the participants in correlation with their diploma*



From Graph 2 we see that the bachelor participants score higher than the master participants, which is opposite to our second hypothesis. However, the difference is not significant

(F(1;6)=2.208, ns) which means that no score difference is found between bachelor participants and master participants.

Graph 3 *the interaction between the diplomas and different groups*



For a further analysis, Graph 3 shows the interaction effect between variables (presentation and participants' level). It shows that the bachelor participants in audio-visual-without-text group score higher than the master participants in audio-visual-with-text group, which is opposite to what we have hypothesized. But again this difference is not significant (F(1;6)=.166, ns). Table 1 shows the complete results obtained by using ANOVA.

Table 1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4,433(a)	3	1,478	,917	,487
Intercept	187,267	1	187,267	116,234	,000
level	3,267	1	3,267	2,028	,204
group	1,067	1	1,067	,662	,447
level * group	,267	1	,267	,166	,698
Error	9,667	6	1,611		
Total	199,000	10			
Corrected Total	14,100	9			

Discussion

The result of the test shows a difference between the audio/visual-without-text group and the audio/visual-with-text group; however it cannot be testified by the statistic we got. The difference between bachelor and master participants' performance is opposite to what we have hypothesized, though this difference can neither be supported. Our third hypothesis is also to the opposite of the result shown on the graph, which cannot be testified by the data. In overall results, none of our hypothesis can be validate.

Conclusion

Generally speaking, the test result does reveals that the group with more working load (the audio/visual-with-text group) scores lower than the group with less working load (the audio/visual-without-text group). However, this result cannot be supported by the data we got. The reason for this failure can be explained as follows:

1. We have only 10 participants, which is not enough for the sake of the experiment.
2. There was a problem in the design of the experiment, for example, the animation should be shown only once instead of twice.
3. Some parts of the material are difficult to understand for the participants since they are not francophone and couldn't have a good understanding of the material.
4. (Jade) I did an interview after the experiment, one participant (master student in audio/visual-with-text group) told me that he intentionally avoided the text the second time he watched the animation so that he could concentrate more on the content of the material. He said that it helped to comprehend better than the first time
5. We can also hypothesize that the random order of the questions, which didn't respect the order of the text, might had an effect on the participants' scores.

If we have done this experiment more carefully with the material we chose and the way we did, the results would have been more interesting.

References

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5. Cyril Rebetez (2004) Sous quelles conditions l'animation améliore-t-elle l'apprentissage? Mémoire présenté pour l'obtention du DESS STAF