

Students' Visual Attention Distribution on Multilingual Educational Slides – An Eye-Tracking Study

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The European Conference on Education 2024
Official Conference Proceedings

Abstract

Internationalization policies at higher educational institutions in non-English speaking countries have led to an increase in multilingual programs for (international) students. Teaching in such programs often requires the use of multiple languages on educational slides (e.g., PowerPoint), with the same information in English and the local language(s). However, having multiple languages on educational slides can lead to text crowding and processing overload. To investigate how students perceive multilingual slides, we performed two experiments with Indonesian and Japanese students, who use English as their second language. They were asked to evaluate slides which contained text in three languages (English, Japanese, and Bahasa Indonesia), within two layouts (separated-block and mixed). While doing so, their visual attention distribution on the slides was assessed with eye tracking, and their comprehension of the contents was tested. The eye-tracking results showed that the students dwelled their eye gaze longer on the texts in their native language (either Bahasa Indonesia or Japanese) if the slides had a separated-block layout, i.e., when the same information was grouped according to language. For slides with a mixed layout, in which the same information was given line-by-line in a different language, the students dwelled mainly on the text in their non-native language(s). Furthermore, these mixed-layout slides were evaluated as more complex/distracting and required more mental processing effort than slides with a separated-block layout. Nevertheless, the students' content comprehension was significantly better for mixed-layout slides, implying that the mixed layout can be more effective in multilingual education.

Keywords: Learning, Multilingual Slides, Visual Attention Distribution, Internationalization

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Introduction

Internationalization has become a key policy at higher educational institutions, leading to a rapid increase in the number of international education programs. Education in such programs often involves providing the same content in multiple languages, mostly in slide presentations (e.g., PowerPoint). Presenting multilingual slides can be challenging, although many (commercial) resources have been developed to assist multilingual education, e.g., related to translation and presentation (Boichura & Lopatina, 2023; Degani & Goldberg, 2019; Steigerwald et al., 2022). Important aspects in the design of (multilingual) education slides are the amount of information that is presented on a slide, the organization of the content, the typeface, and the layout (Durso et al., 2011; Kahraman et al., 2011; Marchack, 2002; Paul & Seniuk-Cicek, 2022; White, 2018). Typical slide layouts are similar to those used for commercial purposes such as in road signs or advertisements (Bhatia & Ritchie, 2013; Qiu et al., 2018; Sebba, 2013). One is a *separated-block* layout, and the other is a *mixed* layout. Slides with the separated-block layout have the same information grouped according to language, while slides with the mixed layout have the same information in a single block consisting of alternating lines for each language.

There are few investigations on how multilingual slides are processed by students. Related research has been performed using video with subtitles, which investigated content processing during video learning (Baranowska, 2020; García, 2017) and assessment of the learners' visual attention distribution in the subtitle areas, by using eye tracking (Kruger et al., 2014; Liao et al., 2020; Negi & Mitra, 2022; Perego et al., 2010). The present study therefore used similar methods to investigate the following research questions.

- a) How do students evaluate the multilingual educational slides with the separated-block and the mixed layout?
- b) Does students' visual attention distribution differ between multilingual educational slides with a separated-block and a mixed layout, and does it differ per student group (Indonesian and Japanese)?
- c) Does content comprehension differ between slides with a separated-block and a mixed layout?

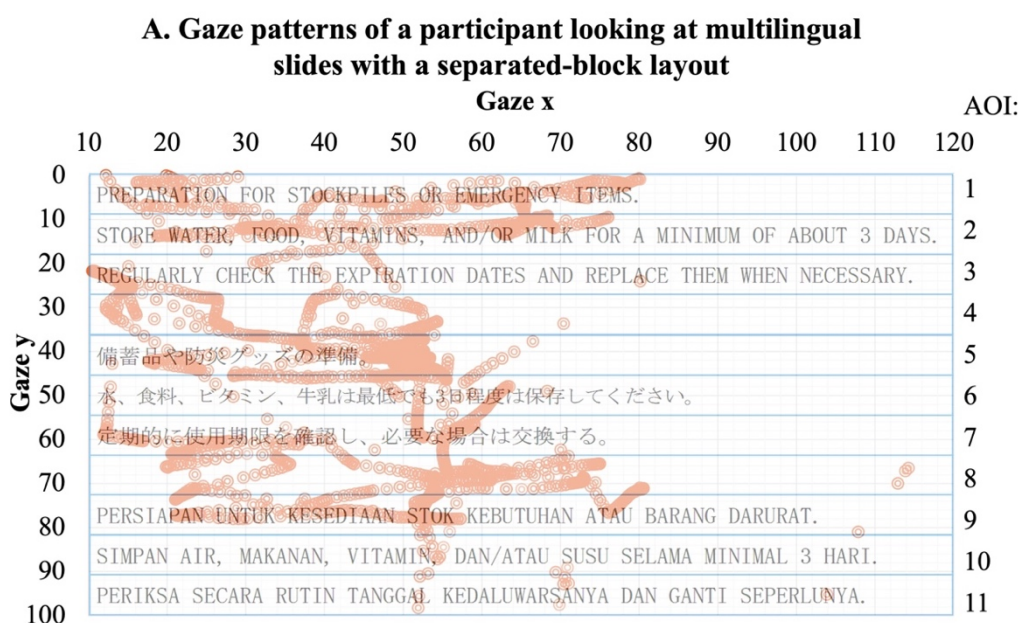
Method

In order to answer these questions, we designed the multilingual slides in a 3×2 factorial design with two factors. The first factor was language, set in three levels consisting of English, Bahasa Indonesia, and Japanese. The second factor was the layout, which could either be separated-block or mixed. In each slide, there were 11 lines of information, 9 with text and 2 without text. Each of these lines was determined as an Area of Interest (AOI) to assess the participant's visual attention distribution by measuring the amount of eye-gaze dwell time on the AOIs. A group of Indonesian students and Japanese students, with English as their second language (L2), was assigned to watch the multilingual slides, evaluate, and perform a comprehension quiz. In Experiment 1, Indonesian students ($n=18$) received the slides with the separated-block layout, and Japanese students ($n=18$) received the slides with the mixed layout in session one, and vice versa in session two. In Experiment 2, the groups had an equal number of participants according to the language background. One group of 10 Indonesian students and 10 Japanese students viewed slides in the separated-block layout, while the other group of 10 Indonesian students and 10 Japanese students viewed slides in a mixed layout. Details of the methods can be found in Adhani and Remijn (2024).

Results and Conclusion

The evaluation scores in both Experiments 1 and 2 showed for the first time that multilingual slides with the mixed layout, in which the same information was given line-by-line according to language, were evaluated as significantly more complex/distracting, crowded, and required more mental processing effort, as compared to the slides with the separated-block layout. Both Indonesian students and Japanese students (N=36 in Experiment 1 and N=40 in Experiment 2) had the same opinion towards this. In addition, according to the language preference scores in Experiment 2, both Indonesian and Japanese students self-reported that they mostly read the text in their native language (L1) rather than the text in a non-native language(s), including English (L2), when they watched slides with a separated-block layout. In the mixed layout, however, their preferences were more varied, and significant differences were not found.

By using eye-tracking, the students' self-reported preferences could be confirmed. An example of obtained gaze patterns is shown in Figure 1. In Experiment 1, the visual attention distribution on slides with a separated-block layout revealed that they focused more on the AOIs in their first language. This means that 18 Indonesian students predominantly viewed the text in Bahasa Indonesia, while 18 Japanese students mainly viewed the text in Japanese. This result was also similar to that of Experiment 2 for slides with a separated-block layout. Students (N=40) gazed at texts in their L1 (either Bahasa Indonesia or Japanese) for a significantly longer dwell time than at texts in their non-native language(s), including English. However, the results for slides with a mixed layout showed that the participants gazed longer at the text in their non-native language(s), including English, than at the text in their L1. This was significant in Experiment 1, but not significant in Experiment 2. Regardless of this, the comprehension scores obtained in Experiment 2 for slides with a mixed layout were significantly higher than those for slides with a separated-block layout (see Adhani & Remijn, 2024).



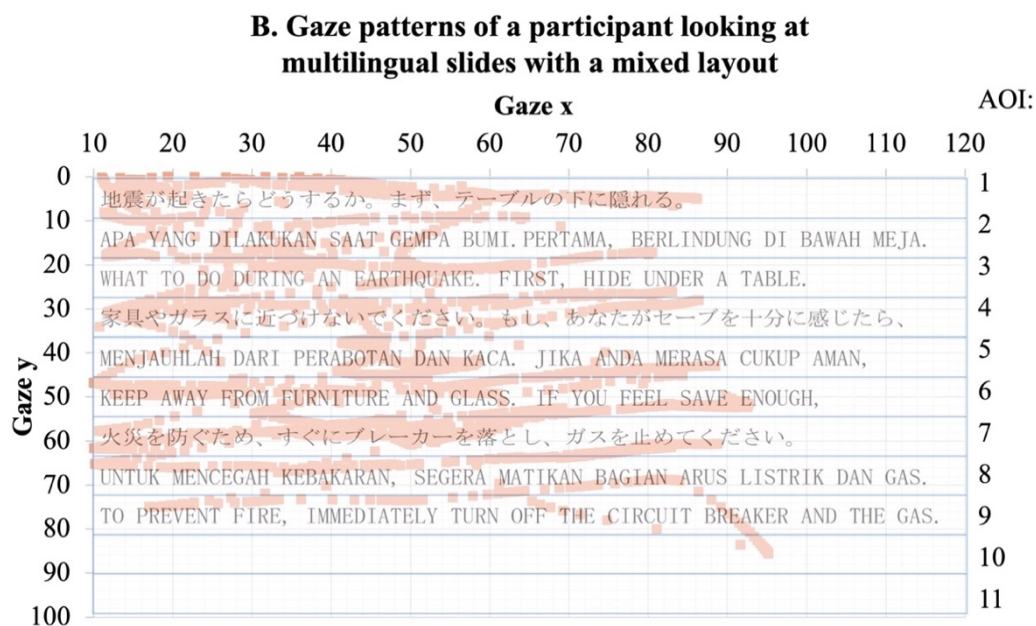


Figure 1. Results of Experiment 1. Examples of a gaze pattern (in orange) on a multilingual slide with a separated-block layout (A) and a mixed layout (B).

The main conclusion of this research is that although the slides with a mixed layout were evaluated as significantly more complex/distracting, crowded, and required more mental processing, this slide layout promoted content comprehension significantly better compared to the slides with a separated-block layout. The relatively better comprehension for multilingual slides with a mixed layout relates to comprehension results obtained after viewers watched multilingual video subtitles (Baranowska, 2020; García, 2017; Kruger et al., 2014; Liao et al., 2020; Negi & Mitra, 2022; Perego et al., 2010). For example, in García's study (2017), students had better test scores for content with bilingual subtitles since they could, arguably, switch between L1 and L2 subtitles and confirm whether they understood the content. Liao et al.'s (2020) study also performed a recall test after the viewers had finished watching video subtitles. In a video with bilingual subtitles, the participants could compare the English words with the L1 to gain their L2 (English). In a similar vein, when using slides with a mixed layout in the present study, by doing this L1–L2 switching students could have been able to compare the languages in adjacent lines and use their language knowledge to confirm the content.

This study has several limitations. First, the multilingual slides were presented within a short duration of 10 seconds for each slide, while the texts were displayed without animation, in black-on-white, without pictures, without formulas or flow charts, and all the slide presentations did not include narration by an instructor. Next, the topics and the quiz questions used (see Adhani & Remijn, 2024) would benefit rote learning, and this does not dovetail with typical learning in higher education. Further investigations are needed to test how the text layout of multilingual educational slides affects learning in the presence of other realistic audiovisual sources. The main practical implication of the present study is that the use of multilingual slides in a mixed, line-by-line layout according to language supports content memorization. Although visually crowded, teachers or instructors can use more than one language on their slides while presenting their materials to students, if necessary.

Acknowledgements

The authors want to express a thank you to all the Indonesian and Japanese participants at Kyushu University who were involved in both experiments. Thank you to Kazuo Ueda, Hiroshige Takeuchi, and Emi Hasuo for their valuable comments on this study.

Funding

This research was supported by a grant from the Japan Science and Technology Agency (JST) Next Generation Researcher Challenging Research Program JPMJSP2136.

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