A Case Study of Data Visualization and Storytelling Workshop for Middle School Students

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Figure 1: All the visual data stories that were produced during the workshop. Some texts were in Thai.

ABSTRACT

Visualization and storytelling skills can be trained during early school years. We aimed to teach visualization knowledge through a workshop whose participants were 100 middle school students across Thailand. With several tangible materials and an assigned topic, a group of five students collected data, mostly from a primary source, produced a visualization and gave a short presentation on data insights. Despite different backgrounds, all groups shared similar visualization types. Concrete and abstract data representations in pictographs, bar charts, and pie charts were popular.

Index Terms: Human-centered computing—Visualization; Applied computing—Education;

1 INTRODUCTION

Visualization knowledge in early school years is of visualization research interest [1]. We designed a visualization workshop for middle school students and analyzed their outputs according to previous work on visual literacy in elementary school [2]. From our experience, visualization and, especially, its critical validation were new to many students and the format of a hands-on workshop worked well to shorten their learning cycles. Some students had

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planned to learn and later conduct their own workshops in their local schools. To improve the workshop, we reflected on the results and future directions.

2 WORKSHOP

All students were in either the first, the second, or the third year of a middle school with a majority of third-year students. Their ages ranged from 12 to 15 and the median age was 14. Of all 100 students, there were 57 female and 43 male students. Five students represented a school and also formed a group in the workshop. 7 schools were from Bangkok while the other 13 schools were from various distinct provinces from all over Thailand. Each group was a mix of students of different ages and school years but some were composed of either male or female students only because they were from single-sex schools.

Preceded by a session on internet safety, the workshop was a half-day event in the afternoon on Saturday. There was a brief introduction to data storytelling and how an improperly designed visualization in the news could mislead people. The speakers were from local media organizations. After that, 7 topics were assigned to 20 groups of 5 students to create a visual data story. We would like some variations within the same topic but we also wanted to observe whether there would be some similarity across different topics so each topic was assigned to no more than three groups. All the topics were as follows.

1. Family size and the number of brothers and sisters
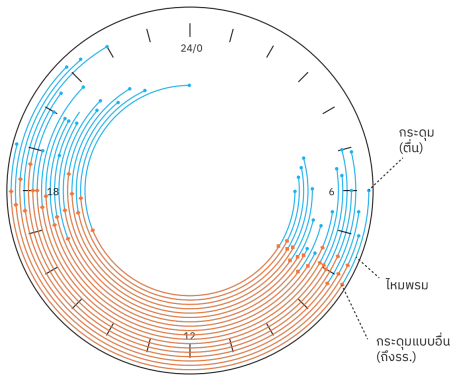2. Bedtime and wake up time
3. Favorite pizza toppings

Figure 2: A design created during workshop topic developement. This was based on a mock-up dataset of bedtime and wake up time.

4. Favorite smart phone applications
5. How one traveled to the workshop location (in Bangkok)
6. Favorite or most popular song lyrics
7. Shoe types and sizes

The topics were chosen to span across interests and fit the schedule, particularly in terms of data acquisition which happened only within the workshop. Datasets were not provided and the participants had to acquire their own data via various methods including quick surveys and secondary data downloads from the internet. The data were also expected to be of different types and scales such as nominal and ordinal scales. We designed a few visualization examples while developing the topics. Although they were not shown to the participants, similar designs as shown in Fig. 2 were anticipated in the workshop results.

The students had approximately 60 minutes to create a visual data story. We provided an unlimited supply of stationery materials including pens, papers, paper clips, rubber bands, buttons, and balloons. Everything came in various colors of unexpectedly matching schemes, probably due to the same source of industrial pigments. After the session ended, there were group discussions for another hour. The students commented on their peers' work and reflected on their own challenges. The speakers and other professionals gave their opinions on the work too.

3 RESULTS AND DISCUSSION

From Fig. 1, there were a variety of visual data stories. Some stories consisted of multiple visualizations. Some stories had no visual encodings; their data were simply written in big numbers of equal size and they were not organized in any visual way.

As summarized in Table 1, pictographs and bar charts were the most popular. Pie charts came in a close second. Other visualizations, Venn diagram and word cloud, were used once. A table might not be universally classified as a visualization but the data were, at least, structurally organized. When there was more than one visualization in a story, a pictograph was among the visualizations.

Venn diagram was the only visualization type we did not mention in the workshop introduction. We conjectured that the students learned about the diagram from their class materials at school. They might have seen one from a website or through social media as well.

Notice that both table and word cloud were only present in the topic on song lyrics. Except the word cloud for song lyrics, none matched the visualizations we made prior to the workshop. For instance, no visualization for the second topic used the clock metaphor in Fig. 2. We observed that the topic of phone applications seemed to be the hardest to visually illustrate. Only one group did it in a pictograph, arguably one of less abstract visualizations.

Table 1: The summary of all visual data stories produced in the workshop by topics and visualization types.

Topic	Pictograph	Bar chart	Pie chart	Venn diagram	Word cloud	Table
1	2		1	1		
2		1	2			
3		1	1			
4	1					
5	1	2	1			
6	1				1	1
7	1	2				
	6	6	5	1	1	1

The degrees of abstraction varied. Due to our workshop materials, most visualizations were composed of tangible objects and drawings. The visual elements in the charts and diagram were more abstract, compared with the units of a pictograph and a word cloud. In total, the number of abstract data representations was slightly more than the number of concrete or pictorial depictions.

4 FUTURE WORK

The participants went on developing their own work at school. Their own projects included visualizations on school bullying and fake news and also visualization workshops for their classmates. We would like to observe their workshops and take note of the similarties and differences between our and their workshop results.

We noticed some missing elements in the submitted visual data stories. For example, there was no visual encoding of uncertainty in any work. We can explore on the reason of these omissions.

In addition, we can focus on a pedagogical tool implementation [2], a particular visual format such as data comics [3], or a specific group of audience [4] to improve our workshop. For a more detailed analysis, a formal visualization literacy assessment [5, 6] will be helpful. We speculate that students with better visualization literacy skills are more likely to use abstract visual representations.

REFERENCES

[1] F. Chevalier, N. Henry Riche, B. Alper, C. Plaisant, J. Boy, and N. Elmqvist, "Observations and Reflections on Visualization Literacy in Elementary School," *IEEE Computer Graphics and Applications*, vol. 38, pp. 21–29, may 2018.

[2] B. Alper, N. H. Riche, F. Chevalier, J. Boy, and M. Sezgin, "Visualization Literacy at Elementary School," in *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems - CHI '17*, (New York, New York, USA), pp. 5485–5497, ACM Press, 2017.

[3] Z. Wang, H. Dingwall, and B. Bach, "Teaching Data Visualization and Storytelling with Data Comic Workshops," in *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems - CHI EA '19*, (New York, New York, USA), pp. 1–9, ACM Press, 2019.

[4] K. Börner, A. Maltese, R. N. Balliet, and J. Heimlich, "Investigating aspects of data visualization literacy using 20 information visualizations and 273 science museum visitors," *Information Visualization*, vol. 15, pp. 198–213, jul 2016.

[5] J. Boy, R. A. Rensink, E. Bertini, and J.-D. Fekete, "A Principled Way of Assessing Visualization Literacy," *IEEE Transactions on Visualization and Computer Graphics*, vol. 20, pp. 1963–1972, dec 2014.

[6] S. Lee, S.-H. Kim, and B. C. Kwon, "VLAT: Development of a Visualization Literacy Assessment Test," *IEEE Transactions on Visualization and Computer Graphics*, vol. 23, pp. 551–560, jan 2017.