Collaborative Graph-Document Composition is Efficient and Enhances Critical-Thinking Skills Without Extra Cost

Koiti Hasida[1,2], Zilian Zhang[2], Zifan Yao[2], Vili Valtteri Karilas[2], Shitao Fang[2], Kuanghuan Tan[2], Kenichi Shibata[1], and Yusuke Matsubara[2]
[1]RIKEN AIP and [2]The University of Tokyo

GDs are easier to collaboratively compose than TDs (Zhang, 2020)

— Hence → Both doc-composition efficiency and CT skills improve by using graph documents (GDs) instead of text documents (TDs).

— EG → Collaborative GD composition improves business performance.

— EG → School education can incorporate collaborative GD composition without extra cost and improve the learners' CT skills. (Hasida, et al., 2024)

— BGof → The content of any TD can be expressed by some GD.

Causes

Contrast

Doc composition efficiency improves by utilizing graphs (Yagishita, et al., 1989)

— BGof → Graphs (concept maps, argument maps, mind maps, etc.) have so far been used not as proper docs but as auxiliary materials for education, idea generation, etc.

— Hence → Graph composition improves CT skills (Ortiz, 2007; Twardy, 2014; van Gelder, 2015; Cottenie & Staempfli, 2016; Barta, et al., 2022)

Left experiment

experiment on synchronous collaboration

— Situation → 9 groups (2 people each) x 9 tasks

— Situation → Each group composed one TD and one GD for 2 different tasks.

— Situation → For each task, one TD and one GD were composed by 2 different groups.

— Situation → In each composition session, the 2 group members used 2 PCs to simultaneously work on the shared doc while talking face-to-face.

work on the document simultaneously while talking to each other

shared document

— Triggers →

Bar chart (text vs graph):
- #points: p=0.0040
- inference length: p=0.0244
- expansion: p=0.0276
- conversion: p=0.3644

Legend: text, graph

Right experiment

experiment at high schools

— Situation → 2022-10/2023-01

— Situation → 100 high schoolers at 2 high schools

— Situation → CT test → 5 graph lessons → CT test

— Situation → In each graph lesson, each group of students collaboratively composed a GD as minutes of their group discussion.

— Triggers → no extra workload on teachers

— Triggers → Students' CT skills improve.

— Specific → The amount of graph-editing operations and the improvement of CT-test score are significantly correlated.

	link creations	link edits	node edits	node moves	multiple regression
total number	1,372	562	445	2,541	
correlation	0.230655	0.228979	0.247175	0.149748	0.297260
partial regression coefficient	0.102856	0.065097	0.102298	0.027833	
t score	2.346645	2.328649	2.525269	1.499331	3.082042
two-sided p value	0.020956	0.021932	0.013165	0.137002	0.002670