Comparing Kit-Build and Figma-based Concept Mapping: Effects of Real-Time Feedback and Implications for Collaborative Problem Solving

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Abstract: This study investigates the impact of the Kit-Build Concept Map (which provides real-time feedback) compared to Figma, a commonly used collaborative design tool, in the context of Collaborative Problem Solving (CPS). The experiment involved two groups of university students who collaboratively solved progressively complex case studies over four longitudinal sessions. The study addresses two research questions: (1) differences in concept map scores between the two groups and their correlation with summative scores and (2) lecturers' perspectives on the benefits of Kit-Build in supporting learning. The results showed that the real-time feedback feature of Kit-Build contributed to consistent improvement in the experimental group's performance, resulting in a strong correlation between the concept map scores and the summative scores compared to the control group. Lecturers viewed Kit-Build as a valuable tool for enhancing student learning through real-time feedback, structured guidance, and efficient concept map construction. They also suggested enhancements such as complexity estimation and more instructive feedback to further support assessments and student comprehension.

Keywords: collaborative problem-solving, Kit-Build concept map, real-time feedback, Figma, longitudinal quasi-experimental

1. Introduction

Concept maps are graphical tools used to organize and represent knowledge (Novak & Cañas, 2006). Widely used in educational settings, they foster both individual learning and collaborative thinking, especially in tasks such as Collaborative Problem Solving (CPS). The way students compose concept maps can be categorized into two styles: (1) open-ended and (2) closed-ended (Hirashima, 2019). In an open-ended style, a learner has the freedom to integrate any concepts and connecting terms within their concept map. In contrast, in the closed-ended style, a learner is required to utilize only the concepts and linking words that have been provided in advance (Hirashima, 2019). A closed-ended map requires learners to reconstruct a concept map using predefined components. This reconstructive concept map model can serve as a form of learning assessment to measure how well learners understand what the teacher intends to convey on a particular topic or case study (Hirashima, 2019). Currently, learning assessments generally rely on traditional multiple-choice questions, which may have limitations in assessing the higher-order thinking skills, problem-solving skills, and critical thinking skills (Whitelock-Wainwright et al., 2020). This study assesses students' problem-solving skills using the Kit-Build Concept Map with semi-automatic feedback (Pinandito et al., 2021) to help them reflect on mistakes and bridge the understanding gap with teachers as a case study in a software engineering course.

For comparison, Figma-based concept mapping was employed in the control group. Figma is widely used by software engineering students for tasks like prototyping and brainstorming (Borysova et al., 2024; Zambri et al., 2024), but it lacks educational scaffolding features such as structured guidance and real-time feedback found in Kit-Build (Hirashima, 2024). In this study, the control group utilizing Figma was provided with the same conditions as the experimental group, specifically by employing a close-ended concept map (with nodes and links provided). This approach ensures a fair and rigorous comparison under equivalent conditions, enabling an objective measurement of the differences between real-time feedback in Kit-Build and manually provided feedback from lecturers within the scenario of a longitudinal quasi-experimental study.

Additionally, this study investigates how concept maps can support CPS, a key 21st-century skill, in the context of software engineering education. In particular, we examine how the Kit-Build Concept Map and Figma support or hinder collaboration and shared understanding during problem-solving tasks. While traditional learning assessments tend to focus on individual knowledge acquisition, many of today's complex challenges require collaborative efforts. Then, CPS has been recognized as an essential 21st-century competency (Andrews-Todd et al., 2023). CPS has several facets, including communicative participation, social regulation, task regulation, and collaborative activity. However, in software engineering education, students often struggle to engage in CPS activities effectively, especially when dealing with unfamiliar modeling notations or case studies. This gap makes it harder to apply previous technical knowledge, requiring lecturers to review past material instead of focusing on core concepts. Concept maps, especially in the form of closed-ended structures like the Kit-Build system, can provide scaffolding to help students clarify their understanding collaboratively. By offering structured guidance and feedback, concept maps can function both as cognitive tools and assessment instruments in CPS-oriented learning environments.

This study explores the impact of concept maps in case-based learning by comparing two student groups: one using the Kit-Build Concept Map with real-time feedback and the other using Figma. Through four sessions with increasing difficulty, we analyzed their concept map quality and its correlation with summative scores. The research questions in this study are as follows:

- RQ1: How do the concept map scores compare between students using Kit-Build (with real-time feedback) and those using Figma (where feedback is provided in the following session), and how does it correlate with their summative scores?
- RQ2: What are the lecturers' perspectives on the benefits of implementing Kit-Build during the learning process?

2. Methodology

This study involved 118 students—78 in the experimental group (using the Kit-Build Concept Map) and 40 in the control group (using Figma, a tool they were already familiar with) as well as lecturers who participated in a Focus Group Discussion (FGD). As shown in Figure 1, the study was carried out across four sessions over approximately one month, following the regular class schedule to minimize disruption to classroom activities. To avoid interfering with ongoing educational processes, we adopted a longitudinal quasi-experimental design (Maimaiti & Hew, 2025). This approach allowed us to integrate the intervention into regular class sessions over time while maintaining existing class structures and avoiding the need for random assignment.

Before the experiment, a pre-test confirmed that both groups had similar prior knowledge of Software Requirements Analysis. All participants were first-year Software Engineering students at Universitas Brawijaya, which ensured that the study focused on foundational concepts. This aligns with the study's goal of strengthening students' foundation for more advanced topics in software engineering.

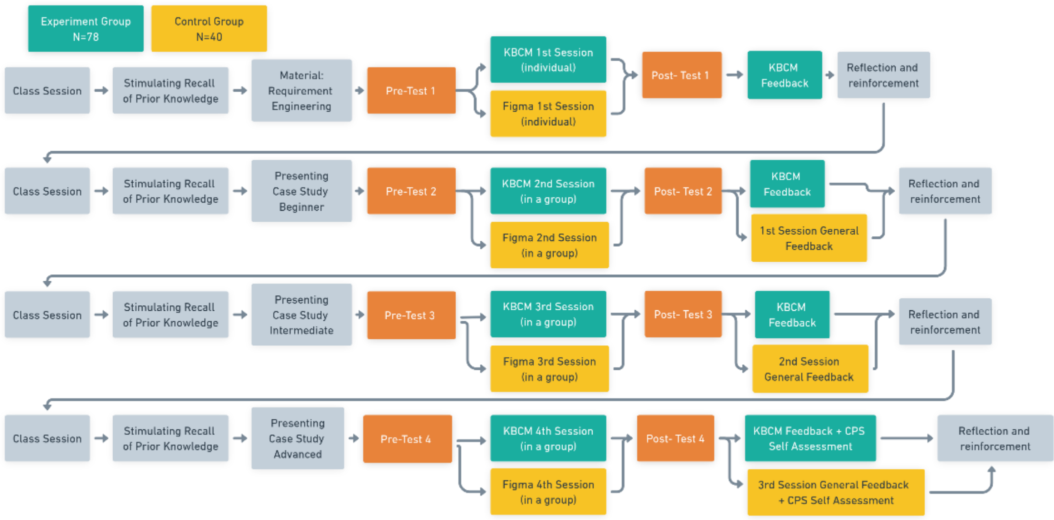

Figure 1. Procedures for the Experimental Group Using Kit-Build Concept Map and Control Group Using Figma

Both groups used worksheets to create closed-ended concept maps with predefined components. Session 1 was individual, helping students get familiar with the tool and recall prior knowledge. Sessions 2 to 4 involved randomly paired students working on increasingly complex case studies. CPS skills were qualitatively observed during collaborative sessions through students' interaction behaviors. The key difference was feedback: the experimental group received real-time feedback via the Kit-Build Concept Map, while the control group received delayed feedback from lecturers in the next session.

To gain deeper insights into users' perspectives on concept map use, a Focus Group Discussion (FGD) was conducted with six lecturers. The FGD explored their prior experiences using concept maps in their regular teaching with familiar tools, as well as their experiences during the current experiment. In addition, the lecturers evaluated the Kit-Build system from both student and instructor perspectives. This allowed them to reflect on the tool's usability and effectiveness, assess its educational benefits, and articulate concrete suggestions for future improvements (Matlala, 2025).

3. Results and Discussion

3.1 RQ1: Comparison of concept map scores between groups and their correlation with summative scores

This section presents the experimental results comparing concept map scores between the experimental and control groups. Table 1 shows the p-values for each session's concept map scores, based on the Wilcoxon Signed Rank Test of the differences of the two groups.

Table 1. *Comparison of Significance Test Results for Concept Map Scores in Each Session*

Group	p-value (1)	Result	p-value (2)	Result	p-value (3)	Result	p-value (4)	Result
Experiment vs. Control Group	3.918e-06	Very Strong/ Significant	0.0006288	Very Strong/ Significant	1.443e-10	Very Strong/ Significant	1.283e-06	Very Strong/ Significant

Based on the p-values for each session, the results showed a significant difference between the concept map scores of the experimental group and the control group, indicating a highly significant difference as p-value < 0.01 (Biau et al., 2010). We conducted an effect size analysis using Rank-Biserial Correlation to assess the strength and direction of the relationship between a binary and a continuous variable. This analysis provides deeper insights into the practical significance of the differences. Table 2 compares the r and U values from the Effect Size test between the experimental and control groups in each session.

Table 2. *Comparison of Effect Sizes (Experiment Group vs. Control Group) in Each Session*

Group	Effect Size 1	Result	Effect Size 2	Result	Effect Size 3	Result	Effect Size 4	Result
Experiment vs. Control Group	0.5205128 U: 2384	Large Effect	0.3846154 U: 2160	Medium Effect	0.7192308 U: 2682	Large Effect	0.5461538 U: 2050	Large Effect

Based on the results in Table 2, the r values are a medium effect($r > 0.3$) for session 2, and large effects ($r \geq 0.5$) for sessions 1, 3, and 4. This means that there is a relationship between the intervention and students' concept map scores. The U value represents the rank value, which approaches the maximum U value of $n_1 \times n_2 = 78 \times 40 = 3120$. A higher U value indicates that the experimental group has better concept map scores than the control group.

Table 3. *Results of the Spearman Method between the Experiment Group and Control Group*

Value	Experiment	Interpretation	Control	Interpretation
Rho value	0.6059594	Strong Correlation	0.4431206	Moderate Correlation
p-value	4.14e-09	Significant	0.004189	Significant

The analysis examined the correlation between the fourth session concept map scores and the summative scores for both groups. Due to the non-normal distribution and ratio-scale data, the Spearman method was used. As shown in Table 3, the experimental group had a rho value of 0.6059, indicating a strong correlation. In contrast, the control group had a rho value of 0.4431, suggesting a moderate correlation, which is lower than that of the experimental group. These results suggest that the Kit-Build system's real-time feedback may have contributed to the experimental group's score improvement, as indicated by the strong correlation between concept map and summative scores. Although the control group also demonstrated improvement, the magnitude of the effect was smaller compared to that observed in the experimental group using the Kit-Build approach.

3.2 RQ2: The lecturers' perspectives on the benefits of implementing Kit-Build during the learning process

To gain a deeper understanding of instructors' perspectives on using Kit-Build and Figma, a Focus Group Discussion (FGD) was conducted with six lecturers. Table 4 presents data saturation results based on insights from these lecturers, coded as L1 to L6.

Table 4. *Results of the FGD with lecturers*

No	Data/Insight	L1	L2	L3	L4	L5	L6
	Experience and benefit from the tools						
1	New Kit-Build users require time to adapt to its lines and colors. However, by the second use, students can easily operate its features during learning.	√	√	√	√	√	√
2	In Kit-Build, students receive instant feedback upon submission, allowing them to reflect on their learning and identify areas for improvement.	√	√	√	√	√	√
3	Lecturers face challenges in providing quick evaluations and feedback on students' concept maps due to the varying structures and layouts created by students.	√	√	√	√	-	√
4	Kit-Build provides hints on the number of connectable components, reducing connection errors, unlike the control group, which lacks this feature.	√	-	√	√	√	√
5	Providing concept map components, along with instructional guidelines, helps students build understanding more effectively and efficiently while reducing confusion.	√	√	√	-	√	√
	Expected improvement						
6	To support lecturers, Kit-Build may include a feature that estimates concept map complexity and the time needed for completion.	√	-	√	√	√	-
7	Kit-Build's feedback could be improved by incorporating teacher map comparisons or clearer instructions could enhance student understanding.	√	-	√	√	√	√

4. Conclusions

The results indicate that using Kit-Build Concept Maps in the experiment group is more strongly correlated with students' summative scores than using Figma in the control group. Kit-Build's feedback feature enables self-reflection, helping students identify and improve weak areas in subsequent sessions. This suggests that Kit-Build supports both metacognitive reflection and structural understanding by enabling learners to receive immediate feedback on their misconceptions.

In terms of Collaborative Problem Solving (CPS) skills, the experimental group showed comparable levels of performance to the control group, despite working within the more structured and constrained format of Kit-Build. CPS skills were assessed based on observable collaborative behaviors, such as communication and task regulation during group sessions. However, due to space limitations, detailed coding schemes, analysis procedures, and results are omitted from this paper and will be reported in a follow-up study.

Nonetheless, the results suggest that real-time feedback and component-based scaffolding did not impede collaborative engagement. On the contrary, these features appeared to support deeper cognitive processing and enhanced group coordination during problem-solving tasks. Moreover, in collaborative settings, the feedback function helped students regulate tasks and coordinate revisions, encouraging more focused discussion and shared understanding. These observations were further supported by perspectives from lecturers who participated in the experiment. Lecturers highlighted that Kit-Build's feedback feature accelerated learning by minimizing the likelihood of students making incorrect connections and alleviating the burden of manual corrections.

These findings align with our initial hypothesis that structured concept mapping with real-time feedback may support not only individual understanding but also collaborative engagement, particularly in CPS contexts. Although the experiment involved a limited number of participants, which may restrict the generalizability of the findings, the results provide promising insights into the effective use of Kit-Build in our specific learning setting. Future research with more participants and varied contexts is planned to further clarify this relationship through detailed behavioral and interactional analysis.

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