題　目　Collaboration with Reciprocal Kit-Build Concept Map: An Analysis of Group Products
（相互キットビルドコンセプトマップを用いたコラボレーション：グループ生産物の分析）

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Effective collaboration is supported by meaningful interaction between group members. Various strategies have been applied to assist learners in collaborating and creating a continuous effort to construct and maintain shared knowledge, such as utilizing a concept map as a representational tool during discourse. While prior studies have established its positive significance on the learning achievements and attitudes of students, they have also discovered that it can lead to students conducting less discussion on conceptual knowledge, compared to procedural and team coordination.

One strategy for improving the quality of students' explanations during collaborative concept mapping (CCM) is to enable them to externalize their thinking privately, beforehand. Though some studies have suggested the inclusion of an individual preparation phase before CCM, only a few studies have provided a means of sharing individual knowledge. Increased awareness of a partner's understanding is also essential in reducing miscommunication and improving the efficiency of the shared knowledge construction process. However, students also face difficulties in sharing developed ideas (private knowledge) and integrating them into public knowledge.

While previous studies proposed that the RKB approach allows students to externalize their thinking and comprehend the representation of others' knowledge, prior to collaboration, they have yet to evaluate the approaches to building group knowledge. Therefore, this study aims to evaluate the effectiveness of the RKB approach for collaboration. To achieve this, it focuses on conducting an evaluation of the group products, students' perspectives toward the activities, and the process of transfer from individual-to-group knowledge. Further analysis of the group products and the transfer of knowledge, based on the similarity of knowledge between the group members and comprehension of their partner's representations, is performed to uncover patterns of student behavior throughout the activities. In doing so, we are able to identify factors that potentially influence the learning process.

This study was completed in a practical classroom setting at a public university in Indonesia. A linear algebra class was selected as the study subject, as the class relies on various collaborative learning approaches for both in-class and online activities. A single group design was applied to explore the effectiveness of the RKB in a natural setting.

This thesis consists of seven chapters.

- **Chapter 1** describes the research backgrounds, review of existing literature, and identifies some of the challenges to this study. The research objectives and research questions that guided the study are also presented, followed by the general structure of the thesis.
- **Chapter 2** explains some of the relevant prior research in the context of CCM, the KB concept map, and the RKB approach.
- **Chapter 3** outlines the CCM activity with RKB, the characteristics of the participants and course subject, experimental procedures, and collected data.
- **Chapter 4** presents an evaluation of group outcomes after students followed the RKB approach. It also analyzes how students change their propositions, from the individual to the collaborative phase, based on the visualization of the difference map provided by the RKB system. Perceptions of students during these activities are examined to measure the effectiveness of the approach from the viewpoints of the participants.
- **Chapter 5** aims to identify the effect of different group compositions on learning effectiveness, at the level of interaction between the individual and the group and at the level of the group as a whole.
- **Chapter 6** presents an investigation into predicting group outcomes based on individual maps: The correlations between the similarity of individual knowledge represented in the first-phase maps, the comprehension of partners' representations during the second phase, and the change of map scores are all analyzed. It also discusses the ways in which patterns of knowledge transfer from individuals to group maps, exhibiting how group products are built based on individual inputs.
- Finally, in **Chapter 7**, the study draws its conclusions and suggestions for potential future studies are made.

Based on the group products, patterns of knowledge transfer from individual-to-group, and questionnaire results, it is realized that the RKB is a promising tool in achieving high-quality, group solutions, encouraging equal participation, and obtaining acceptance from learners towards activities. The findings of this study convey that the RKB also proves promising in supporting knowledge-building in a collaborative context, despite some limitations in the practical classroom experimental settings. A thorough analysis has been conducted on multi-perspectives. An evaluation of students' acceptance towards activities and an analysis of different group formations are also essential for teachers and practitioners who intend to apply the RKB in their classrooms.