

Reconstruction of Concept Map to Promote Learners' Comprehension on New Knowledge

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Abstract: This study investigated a new extension of reconstruction Kit-Build (KB) concept map, which combined with the open-ended style that calls KB-Mixed. To confirm the learners' comprehension of new knowledge, we compared KB-Mixed and open-ended concept map. This study involved 55 2nd-grade university students who were divided into two groups, experimental and control. Students in the experimental group requested to construct concept maps using the KB-Mixed method, while those in the control group using the open-ended concept map, which calls Extended Scratch-Build. The results indicated that KB-Mixed had a significant impact on learners' comprehend, which was represented by the post-test score. Moreover, the concept maps score assessed by expert judgment showed a significant correlation difference to the post-test score.

Keywords: Concept map, reconstruction, comprehension, new knowledge

1. Introduction

Concept maps are graphical tools for teaching, learning, organizing, and representing knowledge introduced by Novak and Gowin (1984) based on the meaningful theory offered by Ausubel (1963). Kit-Build (KB) is a closed-ended style concept map proposed by Hirashima (2015) aimed to support automatic assessment. In a KB, a learner is provided to nodes and links that are composed of teacher's concept map, and the learner is required to make a concept map by combining them. KB consist of three main stages: (1) A teacher creates a concept map that will become a goal map; (2) The KB system will decompose the goal map into concepts and links called "kit"; and (3) The students will be asked to reconstruct the concept map from the provided kit. Therefore, KB map requests a learner to reconstruct the original map by using provided components, and it can be called "reconstructional concept map" (Hirashima, 2018). Some previous studies have revealed many positive effects on the KB concept map to improve learning outcomes (Pailai et al., 2017; Hirashima, 2018), both individually and in groups. However, as a closed-ended concept map framework, KB considers less facilitate knowledge structure comparing to the open-ended concept map.

This study focused on a new extension of KB concept map, which is integrating the open-ended method that calls KB-Mixed. There are two phases of concept map construction as a unity, which is the main characteristic of KB-Mixed to increase meaningful learning and promote learners' knowledge building. To confirm the learners' comprehension of new knowledge, we investigated KB-Mixed and comparing with an open-ended style, which calls the Extended Scratch-Build concept map. In this comparison, we focus on a concept map that provides extensibility through two-phase construction. The present study hypothesizes that experimental groups that utilize KB-Mixed will promote learner's comprehension of new knowledge.

2. Methods

Participants in this study were 2nd-grade university students majoring of informatics engineering. Before determining the group, the lecturer gave a pre-test to ensure that the two groups are

homogeneous ($p = .736 > 0.05$). Fifty-five students were divided into two groups randomly, which consists of 27 students for the control group and 28 students for the experimental group. Students in the control group were requested to make concept maps using Extended Scratch-Build approach, while the experimental group using KB-Mixed.

This study was conducted in the “Basis Data 1” (Database 1) subject which was delivered in Indonesian. We involved an experienced lecturer who is taught this material to conduct theoretical learning in both control and experiment classes. The control and experimental group used the same learning environment, including classrooms, personal computers specifications, and Internet connection. Before the experiment was conducted, at the previous course meeting, participants had been given an introduction to concept maps. Furthermore, participants were also instructed to make concept maps on the introduction of a database topic. This experiment used map construction design twice (phase 1 and phase 2) in one lecture. The main difference between the control group and the experimental group lies in creating the concept map in phase 1, where the control group used the open-ended approach, while the experimental group utilized the KB system. Next, in phase 2, the two groups equally extended the previous concept map by adding new concepts and links.

This study involved two measurements to identify learners' performances: (1) pre-test and post-test; and (2) concept map score. The pre-test was designed to examine whether students in the control group and the experimental group had equivalent knowledge regarding related instructional design. Pre-test and post-test design used the same multiple-choice questions, where the post-test is randomly presented. Pre-test and post-test evaluations were carried out by a class teacher because this study was in class experimental. The teacher who conducted the assessment here was also a teacher who taught in class, a senior teacher with more than ten years of teaching experience in database subjects. The assessment of the concept map is based on propositions by adopting the quality rating of propositions proposed by Osmundson (1999). Propositions scores ranged from inappropriate or incorrect connections (score = 0 point) to most scientific understanding (score = 3 points). There were two midpoints represent practical understanding (score = 1 point) and the scientific understanding of but has limited explanatory power (score = 2 points).

3. Results and Discussion

Post-test was used to measuring learners' understanding after getting an intervention, whether there is an increase or not. The results of the post-test of both control and experimental groups were analyzed by the Mann-Whitney U test and are shown in Table 1. According to the table data, it can be seen that can see that in the mean rank and sum of ranks items experimental group had the highest score. The results revealed a statistically significant difference in learners' learning performance between the control group and the experimental group after the intervention ($U = 259.0, p = .030 < 0.05$).

Table 1

The Mann Whitney-U results of the post-test for both groups

Groups	N	Mean Rank	Sum of Ranks	U	Z	p
Control group	27	23.59	637.00	259.0	-2.164	.030
Experimental group	28	32.25	903.00			

The second measurement which conducted here was students' learning performance related to creating concept maps. The same teacher evaluated the concept map based on the rubric that was set at the beginning. This study also employed Mann-Whitney U statistical analysis to identify map score in both groups. Table 2 show that the experimental group outperformed control group with the significant difference ($U = 75.0, p = .000 < 0.05$).

Table 2

The Mann Whitney-U results of the map score for both groups

Groups	N	Mean Rank	Sum of Ranks	U	Z	p
Control group	27	16.78	453.00	75.0	-5.104	.000
Experimental group	28	38.82	1087.00			

In this study, we also examined whether there was a correlation between the post-test score and map score on the experimental group and the control group. The statistical correlation analysis was performed using Spearman bivariate correlation test. The test results state that there was a significant correlation difference between the post-test score and map score ($p = .018 < 0.05$) with a weak positive correlation coefficient ($r = .318$). It can mean that the use of approaches in creating concept maps can affect student learning outcomes.

4. Conclusion

The present study provided a new extension of the reconstruction Kit-Build concept map to promote learners' comprehension of new knowledge. The findings revealed that the experimental group outperformed the control group in terms of students' achievement indicated by the post-test score. In the results of creating a concept map, the experimental group that used KB-Mixed approach also score better than the control group which used extended scratch-build concept map. Correlation test between the concept map score and post-test score also shows a significant correlation, and emphasize that the use of concept maps methods has a positive effect on learning outcomes.

This study also states that the experimental group with the KB-Mixed concept map approach facilitates learners' comprehension of new knowledge based on their prior knowledge structure. Although the present study did not focus on knowledge building, the concept map results show that KB-Mixed had an excellent potential to facilitate learners' knowledge structure. The stage offered by KB-Mixed, which consists of two interrelated stages, can present meaningful learning well. However, studies of knowledge building and structural thinking still need to be explored more deeply. Therefore, for future work, maybe it would be more appropriate if we involved an analysis of knowledge building and structural thinking.

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