Investigation of Reliability of Kit-Build Concept Map and Collaborative Approach to Build Sharable Knowledge

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Abstract: This paper describes an investigation of a reliability of automatic evaluation of concept map in the framework of Kit-Build concept map and procedure for using it in a collaborative approach to building sharable knowledge. Kit-build concept map is used as the learning task of the concept map for enhancing and assessing learners' comprehension of a topic, which they already learned. This framework is practically used in several kinds of school, but the reliability of assessment has not been investigated. So we try to examine the reliability of assessment of Kit-Build concept map by comparing with the handmade concept map evaluation method that is claimed as the reliability evaluation method for scoring concept map. Because the handmade method is used by a human who can understand the meaning of proposition in the concept map, even the used words do not contain in learning material. After the reliability of our framework is confirmed, we try to propose the collaborative approach that applies Kit-Build concept map for building shareable knowledge between learners. For making the different understanding to the same direction, the collaborative knowledge construction approach is implemented to Kit-Build framework. Learners have to make their concept maps and use the reciprocal Kit-Building that contains summarizing, questioning, clarifying and predicting for sharing their understanding on the different viewpoints, and they must try to harmonize the agreement and disagreement part of the topic.

Keywords: Kit-Build Concept Map, Concept Map Evaluation, Reliability, Sharing Knowledge, Collaborative Knowledge Construction

1. Introduction

A concept map is used for representing and organizing knowledge. However, it is also utilized for assessing learners' understanding widely. Kit-Build concept map is an automatic concept map framework that adopts concept map for enhancing and assessing learners' comprehension in the form of learning task of exercise. After learners learned a topic, they will be evaluated their understanding and instructor tries to analyze the difference between their understanding and instructor's objective. Kit-Build concept map is used in several kinds of school practically such as science learning in elementary school, geography in junior high school, and learning English as the second language. Nevertheless, it does not have investigated the reliability of the assessment method, the propositional level exact matching. So we try to confirm the reliability of this evaluation by comparing with the handmade concept map evaluation method, which is acceptable widely. If the correlation between Kit-Build concept map and the reliable handmade concept map evaluation is a positive relationship, we can conclude our framework is suitable for evaluating concept map.

The abilities of Kit-Build concept map and collaborative knowledge construction technique are focused on producing the procedure for making sharable knowledge between learners. The reciprocal teaching activity is chosen to integrate with our framework as the reciprocal Kit-Building procedure. The four principal strategies of reciprocal teaching that contain summarizing, questioning, clarifying and predicting are utilized as the main core of sharing knowledge process. And supporting of Kit-Build concept map can represent the different viewpoint of each learner that will give opportunities for learners to make agreement part and disagreement part on the topic easily. This procedure will push forward learners to give and take the knowledge between each other during learning situation well.

2. Literature Review

In this study, we investigated a lot of research about the concept map evaluation method and the collaborative learning. For the concept map evaluation method, we try to find the handmade concept map evaluation method that is a typical one for comparing with our automatic concept map framework reasonably. And the theory of collaborative learning process is necessary to guide the designing of knowledge sharing procedure that we try to apply Kit-Build concept map on it.

2.1 The concept map evaluation method

From our literature review, we separated the concept map evaluation methods into two groups. That is the handmade concept map evaluation method and the automatic concept map evaluation method.

2.1.1 The handmade concept map evaluation method

The concept map evaluation methods in the handmade group are used by the human who can understand the meaning of the proposition. In this study, we focus on the methods that pay attention to the structure of concept map and the meaning of proposition of concept map. The Novak and Gowin structural scoring (Novak & Gowin, 1984) is the typical handmade concept map evaluation method that investigates the structure of concept map such as the level of the hierarchy, characteristic of a branch, crosslink and so on intentionally. This method gives high scores for each correct level of the hierarchy and each valid crosslink. Because ordering the concepts into the hierarchy and connecting the crosslinks can facilitate constructor to have creative thinking. But it tends to the structure more than the meaning of the proposition, so it gives only one score for each valid relationship of proposition and example. After that, the methods for investigating the meaning of proposition are purposed. These methods consider on the meaning and do not concern about the structure of concept map as the proposition precedence. Scoring by meaning criteria is accepted widely. These meaningful methods always have a printed set of criteria as the rubric for assessing knowledge and for giving feedbacks differently. However, we focus on the relational scoring method from McClure and Bell. It is one typical assessment for scoring concept map. The evaluators must score concept maps individually by evaluating each proposition separately (McClure & Bell, 1990). The procedure investigates the suitability of meaning of each proposition. If the linking word is appropriate with concepts clearly, that proposition will get three scores as a perfect score. The score will be depreciated depending on the meaning of linking word. For the reliability of this method, they claimed this method has the most reliability when the using with the master map by comparing with the holistic method and the Novak and Gowin structural method. They confirmed it by using g-coefficient value (McClure et al., 1999).

2.1.2 The automatic concept map evaluation method

Most of the automatic concept map evaluation methods use the criteria map as the target of learning. They compare the learner map with criteria map to evaluate learners' understanding that we call an automatic comparison concept map evaluation method. This comparison inherits the property from the human method that is the structure of concept map and meaning of the proposition. If learner maps are the same as the criteria map, it shows that learners can understand in instructor's objective well, which includes the understanding of structure and meaning of the proposition. The reason why the automatic comparison concept map evaluation method is desirably used in automatic assessment is the ease of using a matching function to compare learner map with the criteria map reasonably. There are two types of concept maps that we must choose for construct as the criteria map. The formal concept map is the first one that is built by using valid meaning in universe context. It also has more concise relations between concepts. That makes it is appropriate for the automatic evaluation but is hard for constructing the formal concept map by the instructor. The informal concept map can be created freely by any words. It is easy to construct but hard for evaluating by the automatic method because the system cannot guess the used words thoroughly. For the level of analysis, some method focus on the topographical analysis methods to describe the overall geometric structure of concept map, we call the level structure analysis. But some method chooses to investigate on the attribute of each proposition instead of the overall

structure; we call the propositional level analysis. This level tries to find the valid proposition following its procedure and counts the number of the valid proposition as the evaluating score. One more attractive property is the type of matching method when the criteria map is compared with the learner map. The straightforward matching method that we call the exact matching is used widely. It will accept only the propositions that equal with the proposition of the criteria map. The others will be judged as incorrect proposition merely. While some researchers thought that the exact matching is so strict, so the synonym matching can support more flexible comparison.

Our framework, Kit-Build concept map (Hirashima et al., 2015) is an automatic concept map assessment that uses the exact matching in propositional level for evaluating concept map. It has been already used in classrooms practically and confirmed that the framework and results of the diagnosis were useful to support teachers in science learning in elementary school. Hence it is suitable for using in teaching situation that instructor gives the direction following instructor's interpretation. However, we have not examined the quality of the evaluation. So we produce the experiment to investigate the reliability of Kit-Build concept map by comparing well-known handmade evaluation methods. For using Kit-Build concept map, the instructor has to prepare the criteria map, which is called the goal map in our framework. It is constructed as the informal concept map because it should follow the instructor's objective that requires learners to understand that is not the universe context. After that, the goal map is extracted to the kit that contains a list of concepts and relationships. This kit that is provided to learners can help learners to reduce their cognitive load more than the traditional concept map, which they must create all components by themselves. After that, learners are requested to reconstruct concept map by using the kit; it is called the learner map. The framework will check leaner maps by exact matching on each learner's proposition with goal map's proposition and generates a similarity score. The instructor can investigate learners' misunderstanding individually and can find the overview of all learners by overlaying concept map as the group map and the group-goal difference map immediately. After result analyzing, the instructor can adjust the goal map or teach learners about leaky content again.

2.2 The Sharing Knowledge and Collaborative Knowledge Construction

Collaborative learning supports learners to share their knowledge and makes the classes more active. Learning as a social process incorporates multiple distinguishable phases. They constitute a cycle of personal and social knowledge-building (Stahl, 2000). However, we try to investigate the collaborative techniques that can help learners to share their understanding and make an agreement on each other understanding apparently. Following this objective, we focus on the reciprocal teaching that is an instructional activity in which learners become the instructor (Barkley et al., 2014). Learners will act as in four strategies: summarizing, questioning, clarifying and predicting. Summarizing is a way to help learners reconsider their understanding. Questioning requires learners to think about the topic and forces them to identify areas that are confusing, need for clarification. It allows learners to think critically and get their classmates to do the same. Clarifying is the answering the posed questions. It also points out confusing areas and clarifies them. When learners predict, they send out the idea what can happen next in the comprehension they just learn. It requires learners to examine what has already taken place and utilize their imagination to think ahead.

3. Research Methodology

To confirm the reliability, we produce the preliminary experiment to compare the correlation between the handmade concept map evaluation method and Kit-Build concept map. For the handmade evaluation method, we chose the Novak and Bell structural concept map evaluation and the McClure relational propositional method that they are a typical traditional method.

In this preliminary experiment, ten university students were requested to read the article that described "Introduction of concept map." After that, they had to construct concept maps following their reading interpretation by using 21 provided concepts on CmapTools application. It means they must create linking word by themselves. We used the two handmade evaluation methods to evaluate these concept maps, and the raw scores of each method are normalized by using their perfect score. Then, they had to use Kit-Build concept map to reconstruct concept map by using kit. The kit contained the

same 21 concepts and additional 22 relationships. These concept maps were evaluated by our automatic evaluation methods. The score is represented as the similarity score when learner map was compared with the goal map. After reading situation, the participants were taught about the same article following instructor's interpretation, and they were requested to construct the concept map as same as step in reading situation. They had to create linking words by themselves and Kit-Build concept map.

In the part of sharing knowledge, the objective of sharing knowledge is to make an agreement on specific knowledge each other. We try to use the ability of Kit-Build concept map and the collaborative learning technique to support in this situation. The reciprocal Kit-Building, which is an integration of reciprocal teaching and Kit-Build concept map, is proposed. After learning situation, learners are paired, and they have to summarize their understanding as a concept map. After that, their concept maps are extracted to be a kit, and it is provided to their partner. Then, learners are requested to construct Kit-Build map by using the kit, which is decomposed from their partner's concept map. Afterward, the difference map of each Kit-Build map is generated, and learners have to discuss how their concept map different with their partner by questioning and clarifying. The difference map of our framework can represent the different viewpoint of each learner when learner map is overlaid. After the discussion, learners should build the shared knowledge between them in the form of agreement and disagreement part. And they should predict ideas of what can happen next in the comprehension they just learned. However, learners can represent their common knowledge in several formats such as the concept map, report and so on. It depends on the characteristic of the common knowledge that they got and the learning strategy that the instructor used.

4. Current Work

From the preliminary experiment result, we compute the correlation between the score of Kit-Build concept map and the handmade methods. The p-values show we cannot discuss the correlation between both structural and relational method with Kit-Build concept map in reading situations. Because, when the learners read the material, they interpret the information by themselves, and it is possible to be various ways. While the result from teaching situation has a marginal medium correlation between both handmade evaluation method and Kit-Build concept map, it shows the lecture from instructors can make an agreement on that material by teaching and guide the learners' understanding to the same direction with the instructor. From the assumption that the handmade concept map evaluation is reliable, the results suggest Kit-Build concept map is reliable for evaluating concept map in teaching situation by comparing with the handmade evaluation methods. However, we desire to make more definite confirmation of Kit-Build reliability by using g-coefficient value in a full experiment. And the stability of handmade evaluation method is analyzed because it may affect the quality of evaluation.

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