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Reference Information Model of Concept Map for Improving Learning Achievements

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Abstract: In this paper, we aim to confirm that Kit-Build concept map (KB map) is suitable to improve learning achievements in classroom situation. The main purpose is utilizing KB map on formative assessment to develop ongoing formative assessment. Because our framework contains a concept map construction, assessment and diagnosis tools, which can support to gather and assess learner's evidence well. For using KB map, instructor has to create the criteria as goal map and it will be extracted as a kit. The kit will be provided to learners when instructor wants to gather learner's evidence. After learners reconstruct a kit as learner map, their maps are evaluated by comparing each proposition of leaner map and goal map by exact meaning matching, which is assessing learner's evidence as assessment result in form of similarity score. From this comparison, KB map can generate individual diagnosis result by overlaying learner map and goal map that can represent misunderstanding of each learner by displaying the difference between two maps. In addition, our framework can provide group diagnosis result that shows most common misunderstanding of learners as an overview of class. Both individual and group diagnosis is a great influence to contribute instructor's feedback designing to create intra-class and inter-class feedback. Based on practice results, two strengths of KB map, which are the kit and the group diagnosis, are significant ability and effective to influence on developing ongoing formative assessment in classroom situation. However, these abilities support only instructor role. To encourage leaners to practice their knowledge and skills, self-reflection learning is focused. It can support learners to improve their achievements by themselves. So we would implement the reference information model of KB map for supporting learner's self-reflection. This model will provide the useful information for learner to reconsider their understanding. The provided information contains criteria-referenced as their own map that represent only correct propositions, norm-referenced as overlaying all learners map that shows an overview of class and self-referenced feedback that is their own map in previous step. After this information is provided, the action of learner will respond to self-reflection for improving their learning achievements.

Keywords: Kit-Build concept map, Ongoing Formative Assessment, Reference Information Model, Concept Maps, Proposition Level Exact Matching, Self-Reflection.

1. Introduction

Kit-Build concept map (KB map) is a digital tool for supporting concept map strategy, which includes construction tools, an automatic concept map assessment, and the diagnosis result. It is used to develop framework of Kit-Build concept map (Hirashima et. al, 2015) for using in the classroom situation. The framework of KB map places a stronger emphasis on confirming the understanding between instructor and learners in classroom situations. Based on the ability of KB map and characteristic of the framework, these are suitable to utilize in formative assessment.

The formative assessment is the procedure to assess learner's evidence for learning that includes goal setting, monitoring, and providing ongoing feedback. This procedure requires formative strategy, which uses to represent and assess learner's evidence. The strategy of formative assessment should represent and can assess learner's knowledge, which provides formative information to an instructor. And the instructor design feedback based on formative information is the key to improving learning achievements. We attempt to confirm the framework of KB map is appropriate to utilize in the formative assessment as more as possible for developing the ongoing formative assessment. And the primary purpose is the implementing in order to improve the ability of KB map, which can play a

significant role in encouraging reflective thought and action. The diagnosis results are formative information to contribute instructor's feedback designing that encourages self-reflection of instructor. And reference information model is used for developing a new task to promote reflection of learners.

2. Kit-Build Concept Map in Formative Assessment

2.1 Kit-Build Concept Map Ability

The general practice flow of KB map framework can support through of learning process in classroom situations (Hirashima et. al, 2011). Sharing knowledge from instructor to learners is the lecturing in class, and instructor anticipates learners to understand lecture content in the same intention. An instructor constructs a *goal map* to represent the intention on lecture content that he/she want learners to understand as same as his/her expectation. And the instructor requests learners to construct *learners map* to express what they understand on lecture content. KB map provides a "Kit" that is decomposed from the component of goal map, which includes concepts and relations with linking words. Learners construct the learner's map by integrating the kit, and upload it to the KB map server. An automatic concept map assessment method of KB map is the proposition level exact matching that can generate the useful assessment result and diagnosis result. The assessment results show the similarity score between learners map and goal map that mentions about the progress of instructor's expectation. The diagnosis results report information in the form of three error links that consist of lacking links, leaving links and excessive links. They are used to explain what difference of learner maps from goal map.

2.2 Ongoing Formative Assessment

Formative assessment is the monitoring to provide ongoing feedback. It is used to improve learning achievements. It means the assessing learner's understanding in the classroom situation can support to improve learner's understanding. Figure 1 shows a scenario of intra-class feedback and inter-class feedback in classroom situation when utilizing KB map in formative assessment. An instructor constructs a goal map as a *final state* before being the class and giving a lecture. After that, learners are requested to construct learners map for checking their understanding following check point, which is the way for identifying *learner's state*. The automatic diagnosis of KB map provides the assessment result and reports the diagnosis result, which is used to contribute instructor's feedback designing (Sugihara et. al, 2012). The instructor's feedback is the key to improving learner's understanding. And it is also the way to closing the gap between learner's state and final state. The kit, the proposition level exact matching, and the diagnosis result are main reasons that make an advantage of KB map when using in the classroom situation.

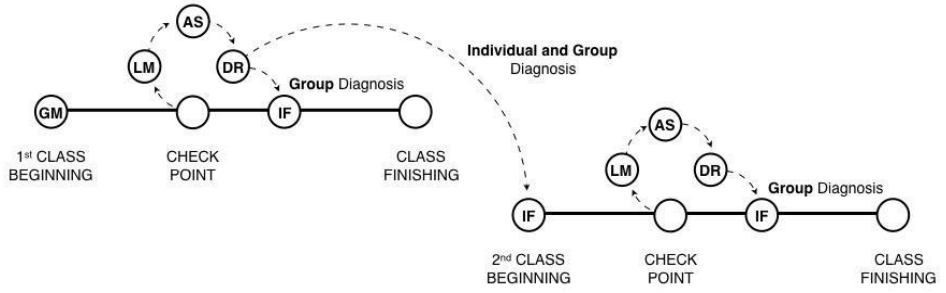

Figure 1. Intra-class feedback and inter-class feedback in classroom situation.

The kit is a list of concepts and relations with linking words. It is decomposed from the goal map and is provided to learners when they construct learners map (LM). It can confirm understanding between instructor and learners on lecture content by using the same components, and it is possible to use the kit to assess learner maps by using the proposition level exact matching. Several researchers proposed various approaches for concept map assessment such as using synonym words and graph theory, but it requires the instructor to confirm the result before identifying learner's state. The assessment result of the proposition level exact matching can identify learner's state clearly without instructor's

confirmation that is the ready-to-use result. Moreover, the same component can be used to generate the group map of learners. The group map can represent the most common understanding of learners, which is additional learner's evidence in term of formative assessment. The propositional level exact matching and the group map are advantages of KB map for investigating the progress of learners.

The diagnosis result (DR) is one more advantage of KB map that provides effective information to contribute instructor's feedback designing. The diagnosis result in the form of three error types can represent what is the difference of learners map from goal map, which is called the individual-goal difference map. The error links can address to critical areas that are important incorrect propositions, and instructor should focus at the time. Especially, the additional information of KB map is the group-goal difference map, which can represent the most misunderstanding of learners. The instructor can recognize most common misunderstanding of learners in a one-time analysis. In this point, the group-goal difference map creates a chance to develop the ongoing formative assessment. Considering the number of learners in the classroom may be impossible to recognize all of the learners in a class period. To give feedback in next class (inter-class feedback) for improving learner's understanding may be too late. Nevertheless, the group support diagnosis of KB map can provide the additional information to an instructor that is possible for designing and providing instructor's feedback in a class period (intra-class feedback). The effectiveness of KB map in ongoing formative assessment is confirmed by the practically use in elementary school. The result shows KB map can utilize in various practice flow and can contribute instructor's feedback designing positively. And we emphasize on the providing information process, which is important to support instructor's feedback. As more as possible to address critical area always increases opportunities for instructors improving learner's understanding.

3. Reference Information Model

Proposition level exact matching of KB map can be represented as the comparison method that is used to generate feedback. The instructor can use this feedback to improve understanding of his/her learners. In the previous section, the main contributions are the ability of KB map for developing the ongoing formative assessment that supports only instructor role. For supporting learner role, we continue the developing of a new feature from the comparison method for encouraging learner's reflection that is a reflector of KB map. We would implement the reflector by using three types of feedback from the reference information model which contains criteria-referenced feedback, norm-reference feedback, and self-referenced feedback.

The reflector of KB map is an additional task of learners when they completed a map. KB map can provides the reference information model for supporting learner self-reflection well. This task requires learners to think about unconfident propositions, which are mentioned by reference information model, again. From the definition of the reference information model, the self-referenced feedback means a lot of movement based on learner's behavior of the previous map. The criteria-referenced feedback is the difference of propositions between the learner map and the goal map. Last, the norm-referenced map is the relative movements' frequency of learners in the same class. In the reflection of KB map, it will highlight unconfident propositions to active learner's reflection and confirm their understanding again.

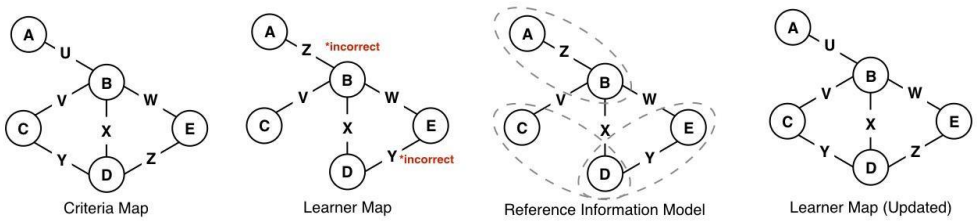

Figure 2. An example of learner's map transitions with reference information model.

The reference information model can identify confident and unconfident propositions based on learner's behavior. The confident proposition may be considered by movement from learners. If they understand in the proposition well, they can connect concepts and links in a short time and a few changes. In contrast, the unconfident propositions are constructed from their confusion. We can notice

their indecision by investigating the movement of the component in KB map. If they move the link with linking word adrift, it can mention to the area that learners cannot understand and need to reconsider. We assume learners construct their first map following their understanding of lecture content. After KB map analyzes data, the system generates the reflector and provides to learners as the critical areas depending on each learner. The actions of learners after received the reference information model is the response of self-reflection. In this step, learners have to construct concept map with self-reflection because they have to reconsider about their misunderstanding by themselves. From these assumptions, the reference information model will provide an opportunity for learners to self-reflection, which is the way to improve learner's understanding by themselves. Figure 2 shows an example of learner's map transition when the reference information model activated.

4. Experimental design and Evaluation plan

The practices flow when using KB map in the classroom situation of elementary school is situation that an instructor request learners to construct a learner's map three times in each class (Yoshida et. al, 2013). And the investigation covers two classes with different learners group on the same lecture content. The practice results show the number of lacking links (incorrect links) is continuously decreased that can confirm the effect of intra-class feedback. Another result shows an effectiveness of inter-class feedback when intra-class feedback is ineffective. And investigating the practice results by the correlation coefficient between assessment results and standard assessment test score was positive correlation. Accordingly, the practice flows and these results confirm KB map can develop the ongoing formative assessment in classroom situations.

The reference information model is a purpose for developing reflector that is a new feature of KB map for encouraging self-reflection of learners. It is possible to use the same experimental design that request learners to construct learners map three times in class. And the reflector is available to insert in the end of several checkpoints for investigating the effectiveness of reflector. Based on learner's activity on practice flow, the behavior of learners when they construct the learner's map can be used for analyzing and discovering some information, which may be adapted for improving learning achievements.

5. Discussion

Kit-Build concept map is a digital tool that supports concept map strategy. The ability of Kit-Build concept map is suitable to develop ongoing formative assessment in the classroom situation. Especially, the proposition level exact matching and the diagnosis results can contribute instructor's feedback designing that is a key of formative assessment to improving learning achievements. It is the contribution of Kit-Build concept map on instructor role. For learner role, we propose the reference information model and reflector of KB map for encouraging self-reflection of learners. Based on learner's behavior and the ability of Kit-Build concept map, it can identify the propositions which are necessary to require learners to reconsider for improving their understanding.

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