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TAXONOMY OF ANALYSIS LEVELS OF LEARNING EFFECTIVENESS IN COLLABORATIVE CONCEPT MAPPING

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Abstract. Whilst concept mapping has been accepted in many fields, the assessment of concept maps has remained a controversial issue. In this article, a proposed taxonomy for analysis levels of learning effectiveness in collaborative concept mapping is presented. On the basis of Stonayova and Kommers' initial work (2002), learning effectiveness is divided into three levels, the level of individual learning, the level of the group as a whole, and the level of interaction between individual and group. For each level, a number of sublevels are proposed that could be used as a basis for analysis of learning effectiveness in collaborative concept mapping and other collaborative tasks. Experimental evidence on the reliability of the scoring system is presented.

1 Introduction

One of the most promising uses of concept map (CM) is its integration into collaborative learning activities. In this situation the members of a group collaboratively construct their group maps. It supports discussion about concepts and relationships between members of a group. The few studies of collaborative concept mapping do suggest that it could lead to effective discussions concerning concepts and thus enhance meaningful learning (e.g., Novak, 2002; Roth, 1994). But a controversial issue in using CM, both in learning and teaching and research situations, is the method of assessment of CMs. Although some of studies have found that various proposed methods for assessing the CM are reliable and valid (e.g. McClure, Sonak & Sen, 1999), other authors believe that the question of effective assessment is still an open-ended one (e.g. Hibberd, Jones, & Morris, 2002). For assessing learning effectiveness in collaborative problem-solving CM, different levels can be analyzed. Stonayova and Kommers (2002) suggested an initial framework. They assumed three levels for measuring learning effectiveness: individual learning, the group as a whole, and interaction between individual and group. Each level of learning effectiveness has a number sublevels. The present work is based on this framework and presents more accurate names and definitions for sublevels, suggests new sublevels, re-categorises some sublevels, and omits unoperationalised sublevels. A summary of levels and their sublevels are presented in table one. It follows with more specific definitions of sublevels with related Venn diagrams that illustrate each sublevel. It can be used in all collaborative situations, but here it is presented in a collaborative situation with pre-test and post-test CM.

2 Learning Effectiveness at Individual Level

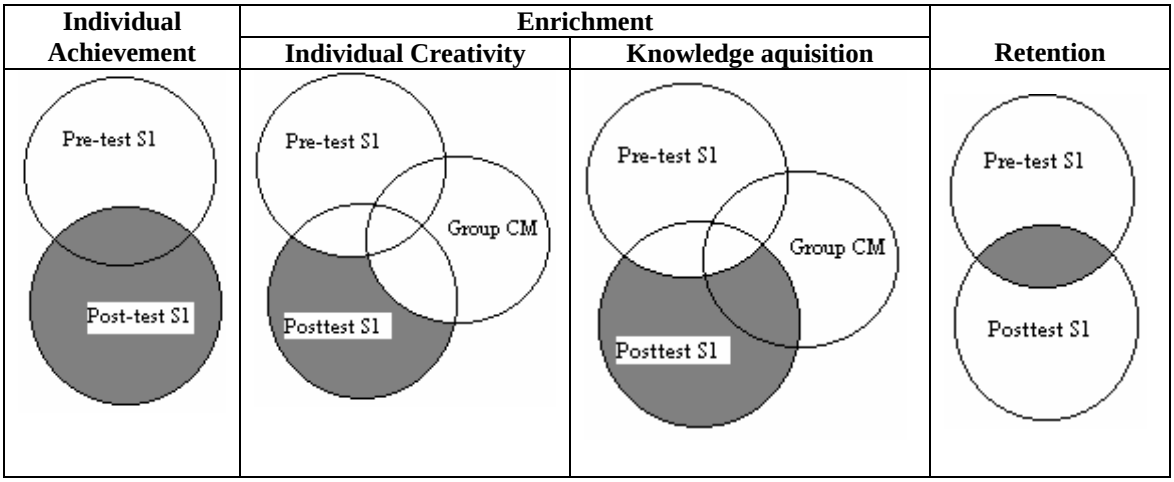

Figure 1. Learning effectiveness in individual level

The analysis unit for this level of learning effectiveness is any CM created individually in pre-test or post-test. Four measures of individual learning effectiveness (individual achievement, individual

creativity, knowledge acquisition, and retention) are illustrated in Figure 1. Each circle represents the total set of the concepts generated during the difference phases of the experiment. The gray areas represent the subsets relating to each measure.

1. Learning effectiveness at the individual level:

Individual Achievement: Total number of concepts in post-test. It includes sublevels of enrichment and retention. (*)

Enrichment: Difference between post-test and pre-test. It includes: (**

1.2.1 **Knowledge Acquisition**: New concepts in post-test. It includes concepts transferred from the group CM and new individual concepts.

1.2.1.1 ***Individual Creativity****:* New concepts that were neither in pre-test nor in group CM.

Retention*:* Concepts are transferred from pre-test to post-test.

Structure & Configuration*:* Distribution of concepts in different levels in relation to central concept. (**)

2. Learning effectiveness at the level of the group, as a whole:

2.1 ***Group Achievement****:* Total number of concepts in group CM. (*)

2.2 ***Structure & Configuration****:* Distribution of concepts in different levels in relation to central concept in group CM. (**)

2.3 ***Group Creativity****:* New ideas and concepts, in group CM, that are not in pre-tests and are created only in collaboration session.

3. Learning effectiveness as an interaction between individual and group achievement

3.1 ***Individual-to-Group Transfer****:* Concepts are transferred from pre-test to group CM.

3.2 **Group-to-Individual Transfer** *(Retention in group level):* Concepts are transferred from group CM to post-test. (*)

3.3 ***Individual-to-Individual Transfer****:* Concepts are transferred from one of peer's pre-test to his or her partner's post-test. (***)

3.4 ***Rejection at Group Level****:* Concepts of pre-test that are not transferred to group CM. (***)

3.5 ***Rejection at Individual Level****:* Concepts of group CM that are not transferred to individual post-test. (***)

3.6 ***Overlapping****:* Overlapping of individual CMs, both between individual pre-tests and individual post-tests. (***)

Note: Asterisks at the end of each sublevels show type of amendment from Stoyanova and Kommers' work (2002): (*) indicates only change of name, (**) indicates change of definition or re-categorisation, and (***) indicates new sublevels.

Table 1: Levels of learning effectiveness analysis

3 Learning Effectiveness at the Group Level

The analysis unit for this level of learning effectiveness is the group CM that is created in collaboration sessions. There are three measures of group learning effectiveness: group achievement, diversity and configuration, and group creativity (see figure 2). Each circle represents the total set of the concepts generated during the group concept mapping of the experiment. The gray areas represent the subsets relating to each measure. The total number of concepts and propositions in the group CM shows the achievement at the group level. Group creativity indicates new concepts and ideas that are generated in the collaboration session. In other word, it consists of concepts are added to the collaborative CM that were not in either of the pre-test CMs. Scores are calculated as proportion of concepts in the group CM that were not in either participants' pre-tests.

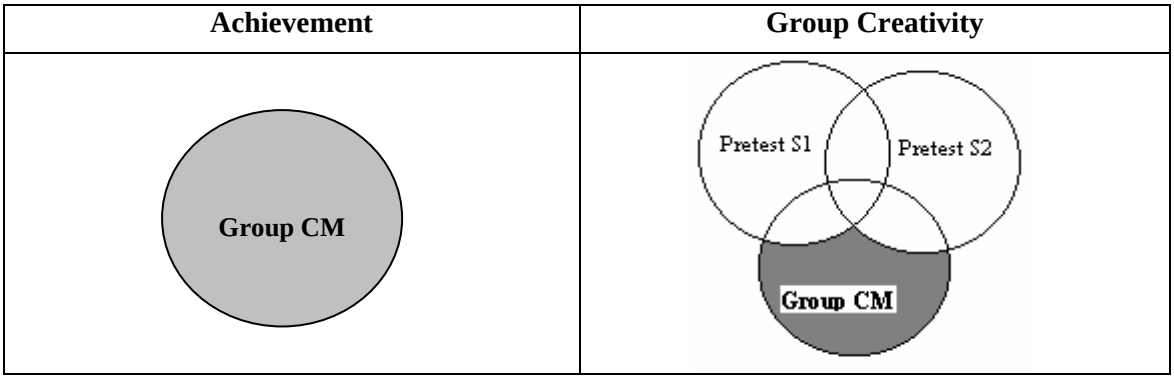

Figure 2. Learning effectiveness at the level of the Group as a whole

4 Learning Effectiveness in Level of group and Individual Interaction

The analysis units for this level of learning effectiveness are the CMs that are created both individually in pre-test and post-test sessions and collaboratively in collaboration sessions. There are six measures at this level: individual-to-group transfer, group-to-individual transfer, individual-to-individual transfer, rejection at the levels of individual and group, and overlapping (see figure 3).

5 Experimental Evidence and Reliability

The taxonomy of analysis level of learning effectiveness was used by Stoyanova and Kommers (2002) and in a set of experiments using synchronous collaborative CM via ICT (Khamesan & Hammond, 2004). These studies show that the scoring system can assist a deeper quantitative understanding of the processes of both learning and collaboration in collaborative concept mapping. Khamesan and Hammond (2004) measured the reliability of the scoring system with three independent raters and demonstrated a high interrater reliability for most of the categories, with correlations between r =.52 for and r= .99.

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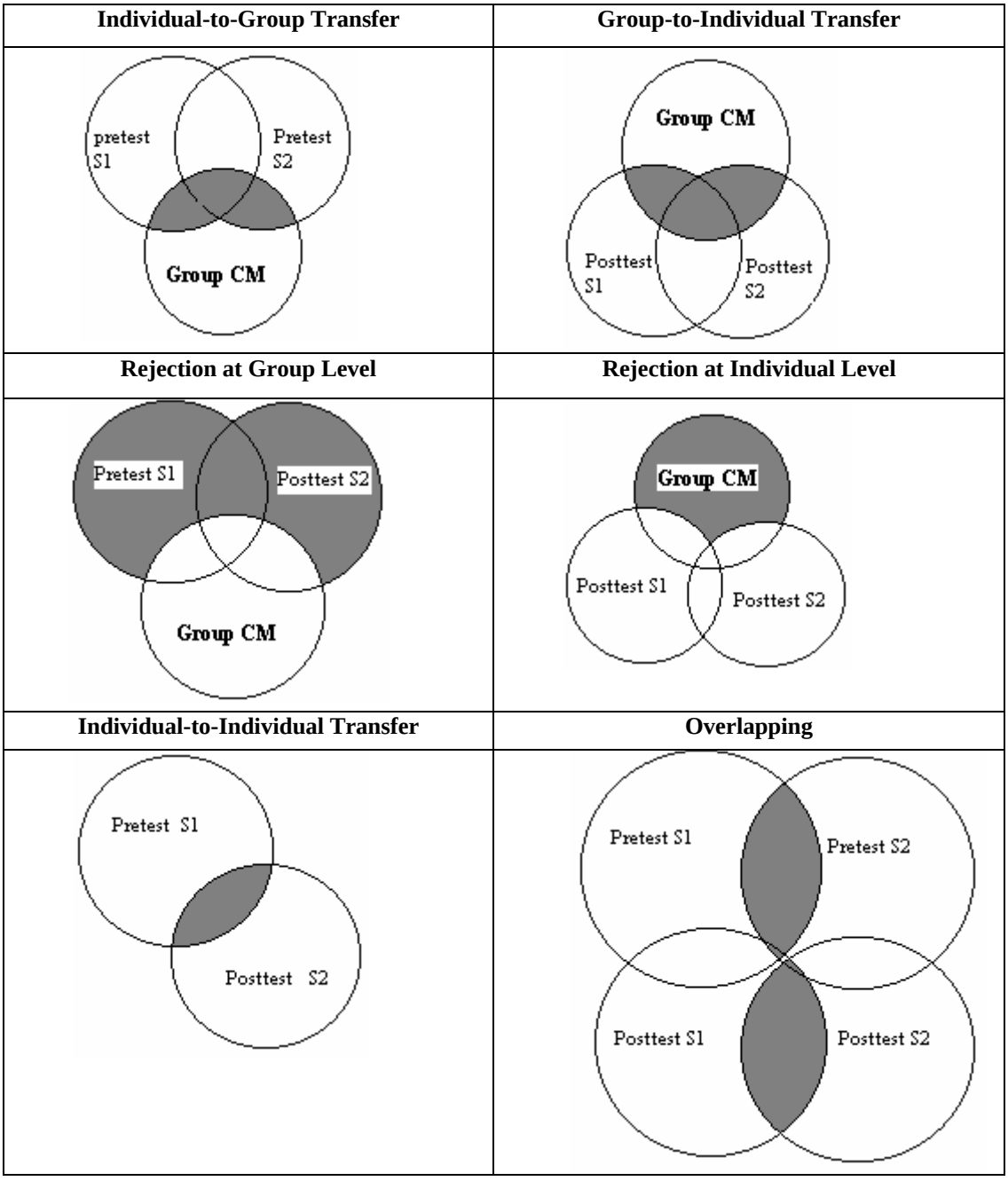

Figure 3: Learning effectiveness as interaction between group and individual