Concept Maps: Making Learning Meaningful
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UTILIZING CONCEPT MAPPING AS AN INSTRUCTIONAL TOOL IN AN AFTERSCHOOL SETTING: A STUDY OF AT-RISK STUDENTS' CONCEPTUAL DEVELOPMENT IN A COMPLEMENTARY LEARNING ENVIRONMENT

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Abstract. The purpose of this study was to determine if meaningful learning occurs in the context of a complementary learning environment. At-risk middle school students participating in an after-school program attended Weekly Learning Sessions to build background knowledge in human geography and develop mindfulness about choices, behaviors, and motivation to succeed in middle school, high school, and post-secondary education. Concept mapping was utilized as an instructional tool in the after-school academic sessions and as an assessment tool to identify misconceptions and areas of strength and weakness in the curricula. The study also provided researchers an opportunity to apply a concept mapping scoring system to student-created concept maps previously used for scoring maps created from transcribed interviews. Student-created maps were based upon topics presented in the after-school program. The results will identify curriculum revisions needed to improve the quality of instruction in the program. Revision will result in better support of at-risk middle school students' conceptual development of human geography content as well as inform researchers about the usefulness of concept mapping in a non-traditional context.

1 Introduction

This study was based upon a complementary learning framework developed for a college reach-out, after-school program in two urban, high-risk middle schools. The afterschool program, Pre-Collegiate Connections Program (P-CCP), incorporated academic and social support for children from low-income families in grades six, seven, and eight. The program occurred weekly in 3-hour sessions led by a certified teacher and undergraduate college students who worked in small and large group settings with students ages 11 through 14. The purpose of the program was to build a community of students within the urban core who see themselves as academically able, emotionally ready, and active in their pursuit of a positive future in middle school, high school, and beyond by entering and successfully completing post-secondary education.

The first academic year of full implementation of P-CCP in grades six, seven, and eight occurred during 2009-2010. After-school Weekly Learning Sessions (WLS) focused on building background knowledge in human geography, which is offered as an advanced placement course in the school district's high schools, and building students' self-esteem and improved self-concept. As the program grew, several strengths and barriers were identified. A strength was the personal connection made between middle school students and undergraduate college students evidenced by the discussions and middle school students' continued interest and attendance in program activities. However, incorporating rigor and relevance in an after-school setting was a challenge. Concept mapping was incorporated 2007-2008 and varied by grade level.

2 Hypotheses

The goal of this study was to examine the use of concept mapping in a complementary learning environment as both an instructional tool and assessment tool. Prior to the study, concept mapping was used as an instructional tool by teachers and as a graphic organizer by students in P-CCP. Concept mapping had not been used as a formal measure of students' content knowledge. We hoped to use the concept mapping assessment results to revise curriculum in ways that better prepare middle school students for higher level thinking activities, increase problem solving skills, and quantify student achievement related to academic content in the P-CCP. The study examined the utility of concept mapping as an assessment tool in the after-school environment by hypothesizing that participants can create concept maps that include linking phrases, and cross-links relevant to advanced placement human geography topics presented in prior sessions. We believed concept mapping could be used successfully with students to measure their understandings and

as a way of explicitly teaching connections among topics. The P-CCP is a non-traditional learning model focused on improving students' higher order thinking skills. Concept maps were rarely utilized in the traditional school day setting and provided us the opportunity to apply an innovative strategy supportive of P-CCP goals.

3 Methodology

The P-CCP design decisions stem from the belief that there is a need for multiple instructional opportunities and strategies to promote the conceptual development and higher-level thinking skills needed for at-risk students to succeed both academically and socially. More often than not, students participating in the P-CCP study have social and/or academic barriers to overcome and are not motivated to work toward success. McCombs & Pope (1994) found that students are capable of understanding the relationships between their beliefs, their feelings, and their motivation and "at higher levels of understanding or consciousness, students can see they have personal control over the content and thinking processes, they can understand the role of thought, and they know they have the ability to be self-motivated"(p.16). Students participating in P-CCP were taught to redirect their thoughts about perceived barriers, gain a different perspective about work, and overcome these barriers with effort and training in skill enhancing strategies that can offset negative influences.

Marzano, Pickering, and Pollack (2001) analyzed selected research of studies on instructional strategies used in K-12 classrooms. The meta-analysis resulted in nine instructional strategies shown to have an effect size of .50 or above. Non-linguistic strategies such as concept mapping or making physical models were found to have an effect size of .75 (Marzano, Pickering & Pollack, 2001). The P-CCP curriculum design included explicit instruction to students about concepts, examples, and attributes using Novak's hierarchal concept mapping strategy.

Paivio's (1990) dual-coding theory of knowledge storage posits that knowledge is stored in two ways—linguistic and non-linguistic (imagery) forms. The development and use of non-linguistic representations of knowledge such as graphic organizers, pictographs, and concept mapping validates the role of knowledge storage in learning. Marzano, Pickering, and Pollock (2001) further found that students who used both ways to store information were more able to recall and apply knowledge. The P-CCP study incorporated the use of non-linguistic representations (concept maps) during WLS in grades six, seven, and eight.

4 Participants/Host School Sites

Host middle schools were located in a large, urban school district in a southeastern state. In 2009, the district's 4-year graduation rate was only 67%, placing it last among the state's districts in the number of graduates produced. Furthermore, the gap broadens when the data are disaggregated by race and economic status. These two challenges—a low percentage of college graduates and low high school graduation rates—are clearly related, and the P-CCP worked to change these trends at host school sites.

Participating middle school students met eligibility requirements by meeting at least one economic factor such as their family receiving state or federal public assistance, free/reduced lunch, and one educational factor such as being a potential first generation college student or low standardized state testing scores. Both schools had higher rates of free/reduced lunch, absenteeism, and suspension than district and state averages. Approximately 100 students in grades six, seven, and eight participated in 2009-2010 P-CCP after-school activities. Ninety-three percent of participants were African-American, 46% male, and 54% female.

5 Instructional Delivery

Instructional program activities occurred after school in collaboration with existing community outreach agencies. Students remained after school and joined WLS for a 90-minute academic block that included four activities. First, students participated in an opening activity to help transition from the traditional school day to the complementary learning setting. Second, students were instructed by teachers for a lesson that provided core content (human geography) for the day's activities. Third, students worked in small groups and individually during a period facilitated by an

undergraduate college student. Finally, reflection activities were led by undergraduate college students to discuss, problem solve, and extend students' understandings of content presented.

6 Procedure and Materials

The study occurred in spring 2010 following 18 WLSs. Data were collected during a 2 week period for each grade. The majority of students had prior experience with concept mapping. A researcher familiar with students, teachers, and undergraduate college students led all study activities and videotaped each WLS. As explained below, the content of the curriculum design varied by grade level. The following example outlines the instructional process used with seventh-grade students.

The seventh-grade study was a summary of content from the previous WLS about landmarks. The researcher reviewed concept mapping terms and activated prior knowledge by reading and reviewing content using a session summary sheet. The researcher then modeled how to create the concept map shown in Figure 1. The content for the seventh-grade study was based on a previous lesson and considered fact-based, declarative knowledge.

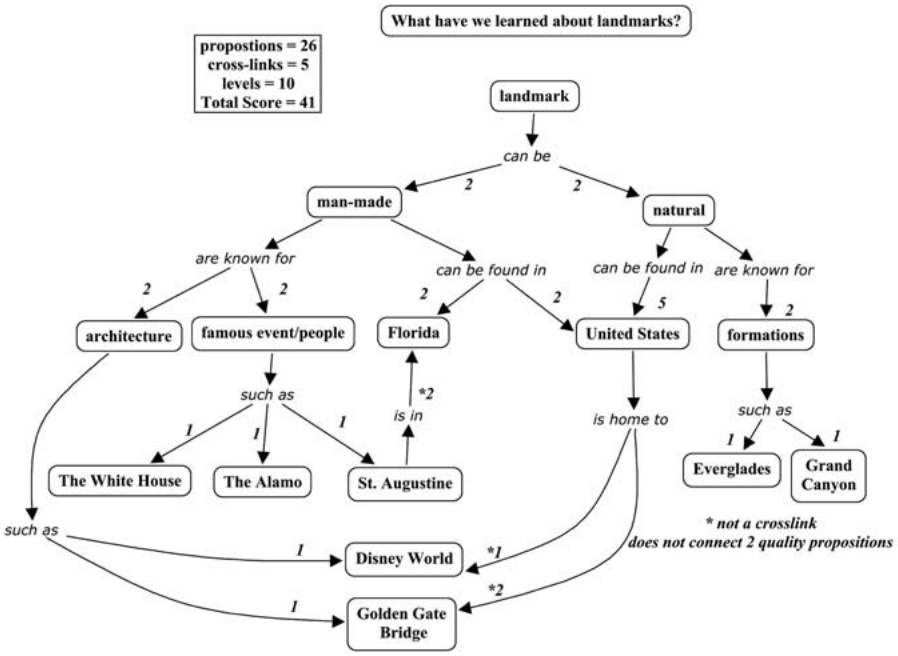

Figure 1. Seventh-grade model map

Students were given a piece of chart paper with the focus question "What Have I Learned About Landmarks?" labeled at the top and an envelope containing sixteen concepts which were used on the seventh-grade model map, four additional concepts from the Landmarks unit, six blank Post-It Notes® for additional concepts, 20 index cards for linking phrases, a glue stick, and pencil. Students worked independently on their maps for approximately 35 to 40 minutes. Undergraduate college students monitored students for on-task behavior and questioned students about the connections made on each map. To conclude the WLS activity, each student shared his or her map with an undergraduate student.

7 Assessment and Scoring

The scoring system (Wehry et al, 2008) is an adaptation of a system developed by Novak and Gowin (1984). The quality of the propositions was scored in a manner similar to that proposed by Kinchin (2000), McClure and Bell (1990), and Yin, Vanides, Ruiz-Prima, Ayala, and Shavelson (2005). The system provides scores for three components of the map: propositions, cross-links, and hierarchy.

The concept map score is the sum of the scores for the three components. Propositions receive 0 points if the proposition is incorrect or is totally irrelevant; 1 point if the proposition is correct but is somewhat irrelevant; 2 points if the proposition describes an attribute of the concept; and 3 points if the proposition states a purpose of the attribute. Propositions Second, cross-links are scored. Cross-links connect concepts in different strings of the concept map. Cross-links connect concepts at different or at the same levels in the map's hierarchy, but to receive points they must link concepts that are part of a quality proposition. Each sufficient cross-link receives 5 points. Last, hierarchy levels are scored. Level one, the focal concept, receives no points. A scored level two receives 5 points when three or more concepts form quality propositions with the focal concept. A level three receives 5 points when new concepts are connected with quality propositions. This scoring system has been used with success in scoring concepts derived from transcriptions of interviews. The P-CCP study provided researchers an opportunity to apply this scoring method to open-ended, student-created concept maps. (Figure 1 for an example of a scored concept map.)

8 Findings and Discussion

Results for seventh-grade participants were analyzed for the number of hierarchal levels, cross-links, total number of propositions included, as well as the overall scores of the maps (n = 26). The model map was used as a comparison map for each student's work. The average scores are reported in Table1 shown below.

ID	**Levels**	**Cross Links**	**Propositions**	**Total of Concepts**	**Additional Scored Propositions**	**Total Score**
MODEL	3.00	1.00	26.00	16.00	0.00	41.00
Average	2.12	0.38	18.42	16.88	2.12	26.38

Table 1. Average 7th Grade Concept Map Scores

The analyses indicated that participants were able to create concept maps with a hierarchal structure, organize propositions in a connected way but had difficulty connecting information across propositions. Additionally, the scoring system previously used with concept maps created from student transcripts was easily applicable for use with student-created concept maps. Seventy-three percent of participants included additional propositions not found on the model map. This outcome could be explained by the climate of PCC-P (non-traditional, academic environment) which promoted creativity and critical thinking via hands-on learning. On average, students were able to organize content using a hierarchical order of at least 2 levels. Furthermore, eighty percent scored level 2 or higher. However, as shown in Table1, the average cross-link score was .38. Less than 40% of students connected propositions with cross-links.

The findings show a need for more explicit instruction regarding how concepts are connected. It seems reasonable to also increase the number of opportunities students have to create concept maps by hand. An explanation for the reported differences could be that students were unprepared to create hand-made concept maps as the majority of their experience was with CMAP Tools. Another factor to consider is the effect of close monitoring by undergraduate students. Does the quality of the relationship between mentor and mentee effect learning or attitude? Revision to the P-CCP curricula will include additional opportunities for students to create free-form concept maps as well as discussion extension activities to increase students' understandings across content topics.

9 Acknowledgments

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