Concept Mapping Narratives to Promote CSCL and Interdisciplinary Studies

Reneta D. Lansiquot, New York City College of Technology, rlansiquot@citytech.cuny.edu
Candido Cabo, New York City College of Technology, ccabo@citytech.cuny.edu

Abstract: Concept maps are used to organize and represent information. In the context of creating narratives, concept maps can be used to represent the elements of a plot and/or the relationships between characters. Concept mapping has been shown to be an effective pre-writing strategy leading to an improvement in student writing. We have investigated the use of concept maps to help students develop narratives in an introductory undergraduate English composition course. We found that students participating in an interdisciplinary learning community (LC) who implement their narratives collaboratively as a video game using computer programming produce better concept maps than students in a traditional English composition course. We conclude that the synergies that develop between English composition and computer programming in the interdisciplinary context of a LC result in more effective concept maps leading to an improvement in students' performance in English composition courses.

Keywords: collaborative writing, concept maps, creative writing, narrative, game-based learning

Introduction

An effective approach for teaching introductory English composition is using concept maps as part of a first-year learning community (LC), a group of students who enroll in two or more courses, generally in different disciplines that are linked together by a common theme, in an academic semester. LCs are one of the ten high-impact educational practices recognized nationally to improve student performance and increase student retention (Kuh, 2008). In this case, students enrolled in Computer Systems (an introductory course to problem solving and computer programming, CS1, and an introduction to the field of computer systems, CS0) and English Composition, EG1, which previous research studies have found to improve student retention and academic performance (see Cabo & Lansiquot, 2014; Cabo & Lansiquot, 2013; Lansiquot & Cabo, 2011; Lansiquot, Satyanarayana, & Cabo, 2014). In our LCs, students develop narratives (schematic structuring of temporal actions or a plot: for instance, the hero's journey structure) and implement their narratives as a video game prototype. In EG1, students collaboratively write original video game narratives in groups and explore human-computer interaction (HCI); in their CS1 computer programming class, students implement these stories using *Alice*, a computer programming environment that supports the creation of three-dimensional animations; and, in the CS0 survey course, students explore artificial intelligence (AI) and hardware issues to describe a possible game delivery platform. The concepts and skills introduced in the computer courses are contextualized by a problem (game design) that is relevant to students and connected to concepts and skills developed in the writing course. The common assignment across the three courses in this LC is a design document, which includes three sections: analysis (video game narrative, target audience, review of competing games, and delivery platforms); design (player characteristics, game mechanics, challenge, and description of the media platform); and project description (video game prototype, review of relevant literature, pseudo code, flowchart, concept map, and storyboards). The review of relevant literature section concerns AI and HCI as these relate to their video game project.

In the LC EG1 course, students used the hero's journey plot structure to write an original background story for a video game and then presented their ideas to the class. A few ideas were chosen to be developed further, and students collaboratively revised these chosen stories with their group, first using concept maps to represent the current story. Finally, students individually developed an engaging character side-quest and accompanying concept map, including the rationale for the importance of such a quest to the protagonist as well as to the target audience of the game.

In the non-LC EG1 course, students integrated digital media to further develop their stories as, for example, a movie. In this course, the design document included the analysis (background story, target audience, literature review, review of existing related narrative projects and unique characteristics, and media selection) and project description (narrative of project design, concept map, and storyboards), but not the design section. The review of relevant literature was replaced by a review of what makes a good narrative related to the genre of

their stories. Student focus was placed creating a background story for a character, and the hero of a video game was used as an example, including the target audience of the story, not of a game.

Students created both group and individual concept maps, which were added to the concept map of the video game narrative. Concept maps are used to organize and represent information. As visualization tools, these diagrams show the relationships between ideas and, in this instance, include linking concepts enclosed in circles and relationships between concepts indicated by a connecting line. These concept maps illustrated, for example, a summary of a background story and the stages in the hero's journey—depicted as a circle, it begins with the Ordinary World then moves to a Call to Adventure; the Refusal of the Call; Meeting the Mentor; Crossing the Threshold; Tests, Allies and Enemies; Approach the Inmost Cave, The Ordeal; Reward; the Road Back; Resurrection; Return with the Elixir and eventually returns to the Ordinary World (Campbell, 1949; Vogler, 2007). Findings demonstrate that the intentional interdisciplinary contextualization of technology-supported collaborative learning helps students make connections that improve general academic performance.

Methods

Students used the *Visual Understanding Environment* (VUE), a free application that provides a flexible visual environment for structuring, presenting, and sharing digital information. VUE also provides support for in-depth analysis of concept maps, with the ability to merge maps. One proposed method of assessing concept maps based on the components and structure of the map (Novak & Gowin, 1984) assigns points for valid propositions (1 point each), levels of hierarchy (5 points for each level), number of branches (1 point for each branch), cross-links (10 points for each valid cross-link), and specific examples (1 point for each example). The number of hierarchical levels addresses the degree of subsumption, the number of branches indicates the differentiation, and the number of cross-links indicates the extent to which the knowledge has been integrated. Another approach to assessing concept maps is to use, and provide students with, a rubric.

Table 1: Concept map assessment rubric

Criterion	4	3	2	1
Breadth of net	Map includes the important concepts and describes domain on multiple levels	Map includes most important concepts; describes domain on limited number of levels	Important concepts missing and/or describes domain on only one level	Map includes minimum concepts with many important concepts missing
Embeddedness and inter-connectedness	All concepts interlinked with several other concepts	Most concepts interlinked with other concepts	Several concepts linked to other concepts	Few concepts linked to other concepts
Use of descriptive links	Links succinctly and accurately describe all relationships	Links are descriptive and valid for most relationships	Some links unclear or vague; some invalid or unclear	Links are vague; show inconsistent relationships
Efficient links	Each link type is distinct from all others, clearly describes relationship; used consistently	Most links are distinct from others; discriminate concepts; present variety of relationships; used fairly consistently	Several links are synonymous; don't discriminate concepts well; don't show a variety of relationships; used inconsistently	Most links synonymous or vaguely describe relationships and aren't distinct from other links
Layout	Map is contained in a single page, has multiple clear hierarchies, is well laid out and provides a sufficient number of relevant examples with links	Map is contained in a single page, has several clear hierarchies, is fairly well laid out and provides a sufficient number of fairly relevant examples with links	Map is not contained in a single page, has unclear hierarchies, is poorly laid out and provides some fairly relevant examples with links	Map is not contained in a single page, is confusing to read with no hierarchical organization

Note: Criteria are evaluated on a 4-3-2-1-0 basis.

We further adapted the concept map assessment rubric found at the Knowledge Innovation for Technology in Education (KITE, 2003), with additions by Josephine McMurray, removing the last criterion "Development over time (for concepts maps where a 'base map' is constructed at the beginning of the course and a corresponding 'final map' at the end of the course" (cf. Table 1; Center for Teaching Excellence, Rubric for assessing concept maps, n.d.). In order to analyze individual student creations, a concept map developed over time was not applicable as their first iteration was developed as a group. Student concept maps included their group story and their individual highlighted side-quest section. In the design document, the group story map was synthesized and all side quests were added to show the complete video game narrative.

Student and school sample

Our institution is one of the most racially, ethnically, and culturally diverse institutions of higher education in the northeast United States: 31% of our students are African American, 35.6% are Hispanic, 20.6% are Asian or Pacific Islanders, 11.6% are Caucasian, 0.5% are Native Americans, and 1.2% Other. The College's fall 2014 enrollment was 17,374.

A typical English Composition course does not include a video game narrative theme and students do not have the opportunity to implement their stories; however, both the LC and non-LC courses help students to develop their ideas by using rhetorical modes including narration, analysis, argumentative, compare and contrast. LC students are recruited randomly and then given a list of linked course options.

Analysis

To quantify student performance, we compared the concept maps of students in our LC (n = 14), with students taking EG1 with the same instructor, but not as part of our LC in fall 2013 (n = 14). All students taking the LC course were majors in the Computer Systems degree and the non-LC students comprised different majors; no two students had the same major. For our analysis, we compared the rubric criterion (0-4) for the different categories of the concept maps (Table 1) between the LC and non-LC groups. For the statistical analysis, group means differences were considered significant at the 0.05 level. We also qualitatively measured student performance by observing their discussions during the group background story concept map production.

Findings

Figure 1 below shows the performance of LC and non-LC students in developing an effective concept map of their story. Performance of LC students was significantly better than non-LC students in all categories except in the use of descriptive links category, which was not statistically significant. When the average of all categories was considered, students in the LC also performed better than students not in the LC.

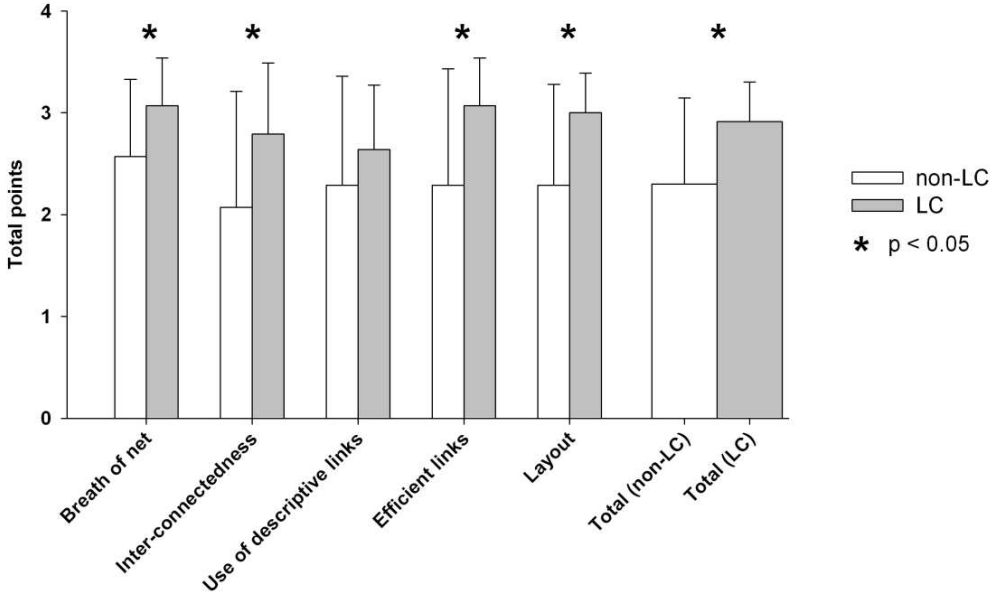

Figure 1. Means and standard deviations of concept map category points for students in a LC (LC in grey; n=14), and not in a LC (non-LC in white; n=14). Totals are the average of all categories. $p < 0.05$ indicates that the difference of the group means is statistically significant.

Students' conversations during the production of the concept maps shed light on these results. Students are not clear on the difference between a flowchart and a concept map, in the excerpt below.

LC Student 1: Is this concept map the same as a flowchart?
LC Student 2: I think so. It's what happens in the story.
LC Student 1: I think we need to show how to make it [the story] happen.

LC students, in the above excerpt, confused a flowchart that illustrates a problem, includes an input, processing, and output with a concept map that represents a story, includes the relationship between ideas. This confusion may explain LC students' non-significant performance in the use of descriptive links as they did not focus on the relationship between links.

Conclusions and implications

Concept maps are not only useful as a learning tool but also as an evaluation tool (Mintzes, Wandersee, & Novak, 2000; Novak, 1991). Based on these data, we can conclude that students in the LC group are able to develop better concept maps than students in the non-LC course. Since it has been shown that the creation of concept maps is an effective pre-writing strategy that improves student writing, it is likely that the use of concept maps will result in an increase in performance in EG1 courses. Therefore, we propose that that increase in performance is the result of the contextualization of the learning experience that occurs in the LC: students apply writing and narrative concepts and skills to problems which are relevant to their interests (gaming) and to their major (computing). The benefit of contextualization could be understood in terms of Ausubel's cognitive psychology idea that learning occurs (Ausubel, 1968) when new concepts are assimilated into existing knowledge and frameworks held by the learner (i.e., into the learner's cognitive structure). The increase in performance could also be related to the fact that students in the LC find meaning in their learning because it relates to previous knowledge (gaming) and since they can relate the EG1 to their major they are more motivated and engaged. It is also possible that the LC environment also contributed to the success of LC students in developing concept maps (Zhao & Kuh, 2004). Further studies will be necessary to understand in more detail the effect of our results, and to assess and compare performance in more specific concepts and skills both in writing and computing for students taking those courses in the context of a LC and outside a LC. For example to correlate the quality of the concept maps with the quality of the actual outcomes such as video game designs, storylines, plots and characters. Students outside the LC were also taking other courses in addition to EG1. It is possible that teaching EG1 in an interdisciplinary LC with courses outside computing may also lead to improved concept map performance.

Computer programming and creative writing in context is effectively a collaborative activity. Not only integrated digital media, but also intentional interdisciplinary approaches to writing allow students to purposefully connect and integrate knowledge. Linking English composition with computer programming in the interdisciplinary context of a LC results in the improvement of students' performance in English composition to similar to the increased level of their performance in the computer courses shown in our previous study (Lansiquot, Satyanarayana, & Cabo, 2014). Therefore, as to allow students outside the major to benefit from the synergies that occur between writing stories and writing programs, we created general education (liberal arts and sciences) interdisciplinary writing-intensive co-taught course, *Programming Narratives: Computer Animated Storytelling*, in which students leverage problem-solving, computer programming and writing skills to produce a narrative-driven video game prototype. Students study the structure of narratives and are introduced to concepts of problem solving using constructs of logic inherent in computer programming languages. Emphasis is placed on creative writing and computational thinking. This course will be offered for the first time in spring 2015 and will include formative and summative assessment of our pedagogical approach.

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