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THE CONCEPTUAL CARD DECK

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Abstract. The conceptual card deck is a game for the collaborative construction of concept maps. It was developed at the *Conéctate al Conocimiento* Project of Panama as an easy way to introduce novice mappers to concept maps and propositional structure, with very little prior explanation of these notions. Though it has been used by some of the Project's facilitators in teacher training workshops, as well as in follow-up visits to schools, this is the first attempt to methodically explore the benefits of its application. The present study's results show that apprentice mappers were able, using the card game, to produce a complex concept map topologically, and of good semantic quality. Aside from providing a practical way to introduce concept mapping, results suggest it may have other benefits as well such as: 1) breaking away from the typical tree structures and one-root concept maps thus leading to a greater variety of map topologies; 2) stimulating the formation of cross-links in a natural manner; and 3) simultaneously promoting competitiveness and collaboration.

1 Introduction

The *Conéctate al Conocimiento* Project was born as part of a national strategy called Panama Inteligente (Intelligent Panama), whose main concern was to foster a new way of learning among Panamanian children, characterized by flexibility, non linearity, and interconnectedness of ideas, so that they may be able to live up to the challenges of our present day world (Tarté, 2006). It is guided by the Secretaría de la Presidencia para la Innovación Gubernamental (The Presidency's Office for Government Innovation), and supported by other institutions, national and international, public and private (see http://www.conectate.gob.pa).

The Project was given a constructivist approach, based on learning tools such as concept maps. Concept maps originated from the work that Novak and his Cornell University colleagues carried out since the early 70's (Novak, 1998, p. 27), based on Ausubel's Theory of Assimilation and its key notion of *meaningful learning* (Ausubel, 1968). In this theory, an individual's previous relevant knowledge is the fundamental element for a meaningful learning process to occur. Concept maps, by enabling the organization and representation of knowledge, constitute a concrete tool to support meaningful learning, as they allow us in some sense "to observe" an individual's knowledge structure, both concepts and relationships among them, for any given domain under consideration (Novak & Gowin, 1984, p. 40).

Much of the effort at the Conéctate Project involves teacher training. Teachers first attend a 2-week workshop imparted by Project, during which they are *re*introduced to concept mapping.[1] At the workshops, most concept maps are constructed using the computer program CmapTools (Cañas et al., 2004), a program that makes concept map construction easier, and allows collaboration between individuals and schools; thus, during the workshops teachers are able to experience the benefits of working with learning tools supported by technology.

Facilitators subsequently conduct follow-up visits to participating schools in order to support teachers in their efforts to implement the meaningful learning methodologies advocated by the Project. During these visits, facilitators have become aware, on the one hand, that teachers confront difficulties in introducing concept mapping to their students, and sometimes give up on maps. On the other hand, they have noticed that students tend to construct rather poor, maps, both topologically and semantically. In terms of structure, their maps generally display a tree configuration, with little ramification, little depth, and practically no cross-links. In terms of content, there are often incorrectly constructed propositions, in the sense that concepts may not be clearly identified and/or linking words may not actually establish any relationship between them (as when *pre*positions are used); in addition, content is mostly classificatory or descriptive, with rather simple linking phrases, and few, if any, dynamic propositions. Nonetheless, upon questioning students about their maps, one realizes that they possess more knowledge than is actually being expressed in their concept maps.

We suspect that the above situation arises from two related facts: 1) after a short workshop of 2 weeks, most teachers are not sufficiently comfortable with the notions like *concepts*, *linking phrases*, and *propositions*, and often introduce concept mapping by conveying these ideas in traditional behaviorist fashion, as "bits" of disconnected information (not always correct) for students to memorize; 2) teachers themselves, upon

[1]Most teachers in Panama knew about concept maps before attending the workshop. However, their knowledge included many erroneous ideas (Miller, Cañas, & Novak, 2008).

completing the workshop, generally construct maps rather similar to the student maps just described (Miller, 2008).

For these reasons, some of the research conducted at the Conéctate al Conocimiento Project has focused on designing strategies to help teachers introduce concept mapping to students in a way that will lead to a better understanding of concept mapping and, in consequence, to more accurate representations of learners' knowledge structures. One area of research and action is the use of ludic methodologies, that is, methodologies based on play.

According to Piaget & Inhelder (1969, p. 65), "play" has an essential role in the life and development of a child, and is "indispensable to [the child's] emotional and intellectual equilibrium."[2] Piaget & Inhelder (1969, p. 66) identify various forms of play, one of which includes "rule games." This type of play begins to appear at around 5-6 years of age, is socially transmitted, and becomes increasingly more prevalent as the child grows older and his/her social life takes on greater significance.

One of the first developments at the Conéctate Project in the area of play methodologies was the *conceptual dice* game, designed by facilitator Adrián Chang (Hughes et al., 2006). In this game, concepts are placed on each of the faces of the dice, and upon throwing them, the player attempts to establish a relationship between the two concept that appear on the upward faces.

More recently, and inspired by the conceptual dice, facilitator Rita Marissa Giovani developed the *conceptual card deck*. The card deck may contain as many cards as desired, on any desired subject. Concepts, either in the form of text, image or both, are placed on one side of the cards. In order to make the cards more attractive to students, they can be made out of Bristol board, of a relatively large in size (for example, 4x5 in), and the side without the concept may be decorated in various ways. Because of their size, cards are placed on the floor, concept-side down (see figure 1). The rules for playing the conceptual card game are detailed in section 2.1.

Figure 1. Conceptual card deck on subject of the "Fairy OddParents." Cards are placed on the floor with the concepts facing down. The up-face is decorated to make cards more appealing to students.

In principle the game could be played with replacement or without replacement of cards. We have chosen to play it *without* replacement, mainly to guarantee that more concepts are used, and also to avoid the practical problem of having to shuffle the cards around on the floor. This specification places a restriction of the number of cards in the deck, which now must be an even number.

Like the conceptual dice, the cards game is also a game of chance in which the learner is required to establish relations between randomly selected concepts. However, unlike the dice, the card game is not limited only to the 36 outcomes appearing as distinct combinations of concepts on die 1 and die 2. Since the card deck can contain as many concepts as desired (provided the number is even), and since any two cards can be chosen, the participants have many more choices of concept pairs that can be mutually related.[3] Moreover, the nature of the game is designed to simultaneously promote collaboration and competition, since team members help each other, and teams compete against each other.

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[2] Translated by authors.

[3] For a deck of n cards, the number of possible combinations is $\binom{n}{2} = \frac{n!}{(n-2)!2!}$. If $n > 9$, there will be more than 36 combinations.

2 Methodology

The present study took place in a school with one of the largest student bodies in the country. It is located in a marginal urban area of Panama City, with many socio-economic limitations. Despite the fact that the school has been incorporated to the Conéctate al Conocimiento Project since 2006, and is equipped with a fully functional innovation classroom,[4] with CmapTools installed on all of its computers, not all of the school's teachers use concept maps.

Given the nature of the study, namely, to use the conceptual card deck to introduce concept maps to a group of students, we sought a group which had had very little or no exposure to concept mapping in the past. The particular group selected corresponded to a 5th grade class,[5] whose teacher did not work with concept maps. Students apparently had had a brief exposure to concept mapping in 4th grade and thus had some idea of what they looked like; however, upon quizzing students it was clear that not much correct knowledge was retained about them.

The group, comprised of 28 students, was divided for the study into two subgroups of 14 children each. Children were assigned randomly to the subgroups. One of these subgroups, designated the experimental group, was to build a concept map by playing the conceptual card game. The concept map was to be constructed using CmapTools and the Cmap projected onto a large screen in order to make it visible to all of the children participating in the game. The focus question was provided by the researchers, as well as the deck of card containing the concepts to be included in the map.

Meanwhile, the second subgroup was further divided into two teams of 7 members each, called control group 1 and control group 2. Each control group was to collectively construct a Cmap with CmapTools as well, using the exact same concepts and focus question as the experimental group. The concepts were presented to them in the form of a "parking lot" (Novak & Cañas, 2008) on the screen of the computers being used.

Novak & Cañas (2008) recommend introducing concept mapping to novice mappers through subjects familiar to them. The use of familiar, non-curricular subject matter is advantageous because it makes it easier for children to integrate personal their experience and creativity. Following their advice, the research team decided to use a T.V. cartoon as the topic for the concept maps.

In order to choose the particular cartoon to be used, in the weeks prior to the activity the teacher conducted a poll amongst her students to determine the group's favorite cartoon. The results of this poll yielded "The Fairy OddParents." A total of 26 concepts based upon this cartoon were then chosen by the researchers and a conceptual card deck was created. This number of concepts was deemed appropriate considering the time available for the activity, 3 and half hours, and the number of children participating. The list of concepts consisted of the following: *Timmy Turner, oranges, clowns, Trixie Tan, babysitter, brain mass, Cosmo, Wanda, fifth grade, California, parents, rules, pool ball, millionaire, professor, Denzel Crocker, comic books, mischief, imagination, family, unhappy, magical creatures, television, school, magic wand, and videogames.* The focus question "What would you do if you were Timmy Turner?" was used only as a loose guide for the Cmap.

Prior to beginning map construction, the experimental group was explained the rules of the conceptual card game. As far as concept mapping was concerned, they were only told that the objective of the game was to relate pairs of concepts selected from the deck in such a way as to create a true, meaningful statement, and an example was given. The control groups were given similar instructions (excluding the rules of the game, evidently); the main difference was that in their case concepts would be selected from the parking lot. Both the experimental and control groups were shown how to construct propositions on CmapTools.

It must be pointed out that this study was not intended as a comparative study: we know full well that students with very little knowledge of what a proposition or a concept map is, and with practically no guidance from "more knowledgeable others," to use Vygotsky's (1978) term, can not be expected to produce "good maps," that is, maps that provide an accurate representation of their knowledge structure in any given domain. In fact, the "no game" condition need not have been included at all; it was included simply as a reference, to provide a feel for the kind of concept map that results from when no knowledge - no guidance is give. Thus, in

[4] Schools integrated into the Conéctate Project are provided with this special classroom, equipped with computers and various other technologies whose specifications have been established by the Project.

[5] The reason for choosing fifth grade was in order to be able to follow these students next year, as most of them will still be attending the same school during 6th grade.

this study the terms “experimental” and “control” are used merely as a way to distinguish between the two conditions.

2.1 Conceptual card deck: the game

TO BEGIN:
The set of players is divided into two teams (of 1 or more members). The cards of the conceptual card deck are mixed and placed on the floor, with the concepts facing down. The teams are given a focus question to guide the construction of the collective Cmap.

OBJECT OF THE GAME:
The object of the game is to create propositions with between pairs of concepts 1) selected randomly from the deck, and 2) already present in the Cmap being constructed.

TURNS:
The game begins with a player from either of the teams uncovering two cards from the deck. The player then has 1 minute to think up a proposition relating the two concepts and place it in the Cmap. If the player comes up with a “correct” relationship, as judged by the entire group of players (both teams), the player is granted two additional chances[6] to establish relationships between any two concepts already present in the Cmap.[7] If the player is unable to establish a correct relationship in any one of his/her chances, the player’s team member may help out. If fellow team members are unable to establish a correct relationship within a minute’s time, the team’s turn is over.

POINTS:
Relationships established by the player whose turn it is earn the team 1 point; relationships established by other team members earn the team only ½ a point.

BONUS
If the player whose turn it is successfully establishes all three relationships between concepts, he/she is given the option of creating a new concept and placing it directly in the Cmap, provided it is used to establish one last relationship (and scoring an additional point).[8]

END OF GAME:
The game ends when the last two conceptual cards from the deck have been uncovered.

WINNER:
The team that scores the most points wins.

2.2 Measurement tools

In assessing the concept maps we used two tools developed at the Conéctate Project: the topological taxonomy (Cañas et al. 2006) and the semantic scoring rubric (Miller, 2008). The former is used to measure the structural complexity of concept maps, and considers criteria such as: presence of linking phrases, hierarchical depth, ramification (breadth), and presence of cross-links. The latter assesses quality of content, and considers among other things: correct propositional structure (propositions as units of meaning), presence of dynamic propositions, misconceptions, and quantity and quality of cross-links.

3 Results

Figures 2, 3, and 4 show the concept maps elaborated by the experimental group, and control groups 1 and 2, respectively (the parking lot of concept, or part of it, can be observed in the Cmaps of both control groups).

[6] The first participant does not enjoy this benefit since there are no previous concepts to relate.
[7] This is where the possibility of cross-links arises.
[8] Control groups did not have the option of adding concepts to the parking lot of concepts given to them.

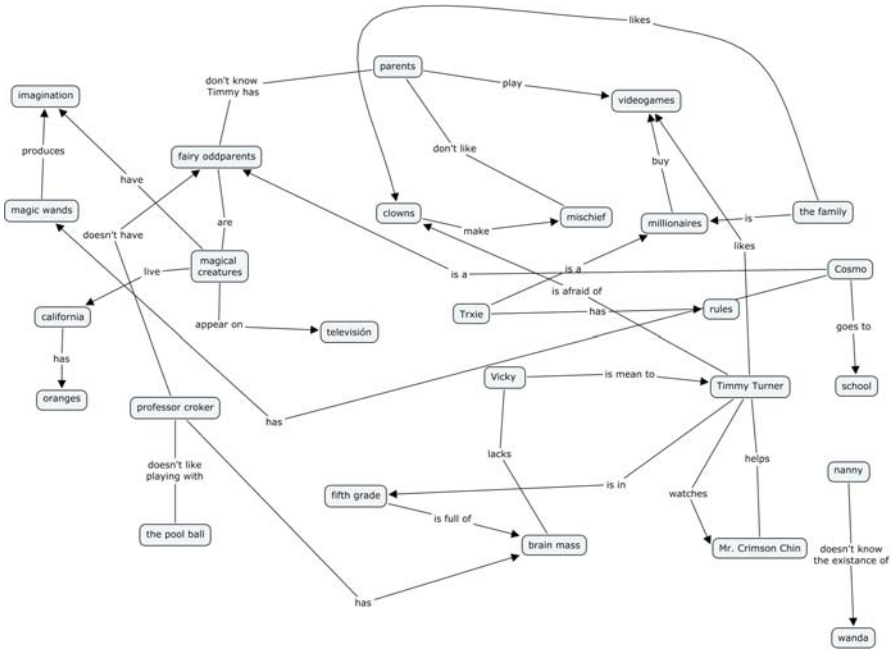

Figure 2. Cmap constructed collectively by the experimental group playing the conceptual card game.

This image of the map does not distinguish between those propositions players created when it was their turn to select two cards from the deck, and those created as a bonus by joining concepts and/or linking phrases already in the map.[9] However, by the way the game was played it is obvious that concepts and/or linking phrases were reused, or else a completely disjoint Cmap would have resulted.

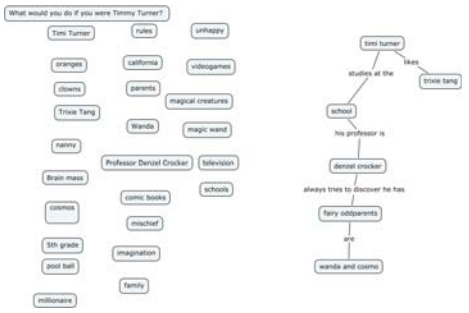

Figure 3. Cmap constructed by control group 1

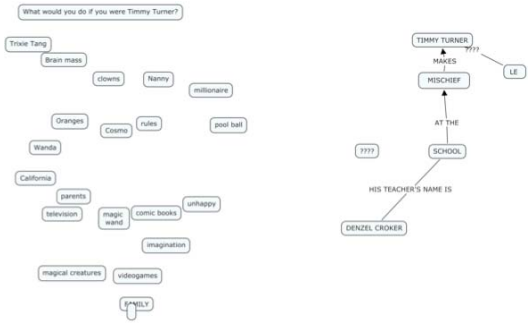

Figure 4. Cmap Constructed by control group 2.

The main features of these Cmaps are summarized in table 1, below. As can be observed, the Cmap generated by the experimental group is quite complex and rich from the structural standpoint: it contains an important number of concepts and propositions, and multiple cross-links. The Cmaps produced by the two control groups are much simpler: they include few propositions, have only one branching point, and no cross links.

[9] Unfortunately we do not have this data available as we did take note of this.

GROUP	Number of concepts in Cmap	Number of propositions in Cmap	Number of cross-links in Cmap	Topological level	Semantic level
Experimental	26	30	10	6	high
Control 1	6	5	0	1	Low
Control 2	4	3	0	1	Very low

Table 1. Summary of basic features of Cmaps constructed by the experimental and control groups.

As table 1 shows the experimental group added the following 4 concepts:

- *Timmy Turner*
- *Vicky*
- *Mr. Red Chin*

One of these concepts (Timmy Turner) was already included among the deck of card; however, at the time it was added, this card had not yet been uncovered. The experimental group also came up with a number of cross-links:

- *Trixie is a millionaire*
- *Vicky lacks cerebral mass*
- *Vicky is mean to Timmy Turner*
- *Professor Broker has cerebral mass*
- *Professor Broker has no Fairy OddParents*
- *Clowns make mischief*
- *Parents play videogames*
- *Timmy Turner watches television*
- *Fairy OddParents are magical beings*
- *Timmy Turner is in fifth grade*

We must point out that although both conditions were supposed to have the same amount of time for their activities, in reality, due to logistic difficulties, the control groups only had 2 hours to build their maps. Nonetheless, one would expect that this would be sufficient time for them to construct more complex maps.

3.1 Topological analysis

A glance at figure 2 reveals that the map produced by playing the conceptual card game has a highly complex structure. Applying the topological taxonomy to it yields a level-6 map, the highest level possible in this classification. This results from the fact that the map not missing any linking phrases, has very high ramification (over seven branching points), is deep (over 2 hierarchical levels), and has multiple cross-links (more than 3). In addition to this, one notes that this map does not have a unique root concept (concepts from which arrows leave, but to which no arrows arrive); in this sense the Cmap is quite different from the typical maps produced by teachers and students alike.

In contrast, the maps of the two control groups are rather simple. By our topological taxonomy they qualify as a level 1 maps due basically to their extremely linear structures (both exhibit only one branching point).

3.2 Semantic analysis

As far as content is concerned, the application of the semantic scoring rubric to the experimental group's concept map indicates a "high" quality map. This follows from the fact that practically all given concepts were used in the map, including 4 new ones added by the participants. This high score is also a reflection of the map's correct propositional structure, the absence of misconceptions, the presence of dynamic propositions, and the many correct and relevant cross-links it contains. An interesting feature of this map is that it is not hierarchical, in the sense meant by Novak & Gowin (1984, p. 15), where narrower, less inclusive concepts are subsumed under broader, more inclusive ones.

On the other hand, the quality of the maps of control groups 1 and 2 resulted in "low" and "very low," respectively, due to the small number of concepts used, the lack of understanding of propositional structure, and the absence of cross-links and dynamic propositions.

4 Discussion of results

As predicted, the two control groups produced very simple maps, both structure-wise and content-wise. This outcome was expected since it is known that, even with knowledge of concept mapping and adequate guidance, it takes time and practice for learners to be able to construct good concept maps (Novak, Gowin, & Johansen, 1983).

The unexpected result, the result we wish to emphasize, is the fact that the experimental group was able to produce a map with a complex, highly non linear, structure, and good quality content, in spite of having practically no knowledge about concept mapping, simply by playing the conceptual card game. It is important to emphasize that this map contains a large number of relevant cross-links, which were placed in the map in a very "natural" manner. In our experience with teachers and students at the Conéctate Project, generally cross-links are added *after* the map is completed, almost as an afterthought.

In addition to the topological and semantic results, the collective construction of the Cmap by playing the card game appears to have other benefits which include:

1. Keen interest and active participation of all the players, since rule games such as this one appeal greatly to young students.
2. Significant interaction among participants, as the group had to discuss and accept relationships before they could be placed in the Cmap.
3. Competition and teamwork, but ultimately a sense of satisfaction among all players, since a joint map was constructed as a result of their "competitive collaboration."
4. Integration of knowledge, as players included propositions that reflected previous knowledge not directly related to the content of the cartoon.

We wish to note that the conceptual card game has been used by the authors in the Conéctate workshops to introduce concept maps to teachers. In every instance, results have been similar to those reported in this article.

5 Conclusions

This paper presented a ludic methodology developed at the Conéctate Project to introduce concept mapping to novice mappers, and reported results of its application with a group of 5th graders from a Panamanian public school. The methodology requires no formal explanation of ideas such as *concept*, *proposition* or *concept map*, and thus may be used without difficulty by teachers who do not yet feel at ease explaining these theoretical notions.

This experience suggests that the conceptual card game is indeed a good methodology to introduce concept maps: using the card game, apprentice mappers constructed collectively a concept map that was complex both structurally and semantically. Particularly noteworthy was the way in which cross-links were naturally included into the map as it was being constructed, rather than at the end, as is usually the case.

These results are important for the Conéctate Project, as they suggest that the conceptual card deck could be used as a way to overcome teacher reluctance to introduce concept maps into their classrooms, often due to their not feeling comfortable with the theoretical foundations underlying concept mapping.

However, an important question that arises is whether the card game produces any long term benefits? That is, if students were asked to construct a map individually, or even in teams, after having been introduced to concept mapping via the card game, what kind of maps would they build? Would these be any better than the maps they would have built if they had not played the game? We hope to look into these and other questions in future studies.

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