Concept Maps: Theory, Methodology, Technology
Proc. of the Fifth Int. Conference on Concept Mapping
Valletta, Malta 2012

LEARNING ROUTES: A WAY TO BRIDGE LEARNERS AND CURRICULUM

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Abstract. Research efforts show that several approaches to learning exist: every person learns in his/her own way and learning performances may severely increase or decrease according to the attention paid to this issue. This article addresses a practical way to appropriately take into account the starting intellectual condition of a person, whenever a teacher, educator or parent has to help his/her learning towards a certain goal.

1 Introduction

After the pre-school age, a person usually enters in a long period of institutional curriculum. A child gets into this school stage with a large range of ideas, attitudes, radicated ways of approaching the world, activities, peers, a family etc. This background heavily affects the way he/she thinks and learns. Sometimes, this intellectual heritage is almost unmodifiable (Gardner, 1993). Sadly, the match between this personal background and the rigor of the curriculum creates situations where the student can be classified as lazy or affected by an attention disorder. In extreme situations, he might even be unable to attend a school anymore (Levine, 2003). Many solutions are out there to solve this problem (Levine, 2006).

Schools or educational staff can choose topics interesting for learners (NCTM, 2000) (EU, 2006). The situation is frequently the same: a teacher in front of some young students. The former says something must be learned, the latter agree partially, or frequently do not agree at all. As a side note, there is a huge amount of scientific evidence that learning evolves better when the student is actively interested and involved in the process (Bruner, 1960), (Bruner, 1966), (Montessori, 1986). Anyway, arranging curricula to meet students' needs is not always possible. That's the point where this paper could be useful. This article does not address the topic of *what* should be taught but it proposes a way about *how* to teach curriculum topics chosen by whoever is in charge of it. The method proposed addresses mainly situations where learning may be difficult.

The rest of this work is organized as follows: Section 2 explains the method proposed and its main steps. Section 3 describes the implementation. Section 4 draws conclusions and proposes possible future research.

2 The method

A general learning situation can be summarized in this way: a student must face a new topic. Of course, this topic is not already inside the mind of the student, or it can be there in a somewhat larger or smaller extent. Anyway an improvement is advisable for a number of reasons. Let's place some starting focus questions to tackle this issue:

(a) how *far* is the student's mind from the topic ? And how can we better describe this "far"?
(b) as above stated, how can an educator build an effective connection between the topic and the student ? And, very importantly, how can we build a *practically usable* connection, not only a theorical one ? By "practically usable" we mean a learning path which is seen viable also or even mainly by the student, and not simply by the educator.

2.1 Step 1: The internal home of a learner

A student starts every learning attempt moving from his/her own internal home: as addressed in a variety of research studies (Gardner, 1993), (Levine, 2002), what we call "internal home" is the entire set of mind habits, memories, social and cultural heritage or traditions, personal theories about the world, other people in the world and family, things and fundamental philosophical issues a person always carries on. Moreover, not only the starting condition of a student differs that way but also the learning approach he/she has to the new knowledge proposed could be very different. This is famously summarized in a groundbreaking work (Gardner, 1981).

Our proposal here is that the teacher or the educational staff as a whole should try to represent the internal intellectual environment of the student using concept maps (Novak, 2010, and bibliography therein). Briefly, a concept map has two key features (Novak, 2006): a central concept to be analyzed and a focus question which should drive the attention both of the concept map builder and the concept map reader. So, how to construct the concept map of the student internal home ? A widely used tool is useful for this goal: CmapTools collects many of the features needed to depict the internal home of a learner in an easy way. Here we propose two ways to accomplish this, but of course many others may arise in the future:

(a) the teacher explicitly asks each student to realize a concept map which represents him/herself. This is a key step and can also arrive after a short initial training of students to get acquainted with the tool. The student should be invited to place him/herself as the central concept of the map. The map can show the following as focus question:

- ”what would you like to spend time for if you could decide your planning entirely on your own ?”
- ”try to describe yourself showing qualities, family, friends, hobbies and so on; try to describe your projects about your desired job, which kind of people you would like to be surrounded by or work with or play with etc.” A similar approach is depicted by Barringer (Barringer, 2010) with the following questions: 1) if you had to design your desired day, what would you be doing? 2) what parts of school are easiest for you and why? 3) what are your affinities - those things you love to do or learn about?

(b) the teacher spends a certain amount of time to build the concept maps of the students' internal home. The author thinks this way has a fundamental drawback: it describes the students’ internal world as the *teacher* sees it and not the way the *students* do. This is very prone to misunderstandings and could lead to failure. After a while, the internal home of the student is described by a concept map. Taking advantage of the graph-like nature of concept maps, we suggest to represent them via the usual graph notation: MH ={V, E} where MH stands for the Mind’s Home of the student, V is the set of all the concepts the students placed in the map, and E is the set of all the links the student drew to connect concepts one another.

Before going any further, the teacher has to sketch a concept map of the topic he/she wants to teach, as large and detailed as possible. This will be addressed as Topic Concept Map, TCM hereafter.

2.2 Step 2: The route to the topic, or the learning route

After the first step, the teacher has a deeper “knowledge” of the student and this knowledge is conceptually schematized. Let’s now address a frequent situation and also the least desiderable: the topic to be taught is not *inside* the MH graph of the learner. In a less formal fashion, the learner does not ”see” it in his/her practical and theorical world of interests. But the concept to be taught is in the end a ”concept” on its own. So let’s place it in the MH graph as an isolated node, i.e. it has no link with anyone of the concepts sketched by the student. The second step of the method is now explained.

We recall a somehow strict similarity to the backward problem solving process described by Polya (Polya, 1981): you have a mathematical problem carrying some data and you should get to a solution, which is not directly linked to those data. You have to build a multi-step connection between the desired result and the actual data you have. Our analogy with the educational problem is clearer now: the student MH cannot be one-step connected with the topic but it might be with a multi-step process. How can these subsequent steps be found ?

Using another similarity with a well-known concept in psychology, the “Zone of Proximal Development” (Vygotsky, 1986) we use here what we call the Node of Proximal Learning (NPL, hereafter). Taking whichever of the nodes (= concepts) written in the MH, the student may be now asked to list topics which he/she is interested in learning, connected to those concepts inserted by him/herself. Of course, new concepts may appropriately be proposed by the teacher to the students to check their reactions. This will eventually lead to a set H made by lists of ”desired” topics. The teacher has now to choose the most appropriate topics from those lists, add them to the MH map and see if any of those topics belong to the topic to be taught.

Two situations may arise:

(a) the intersection is not zero, hence the teacher and the student have built together a meaningful multistep connection between MH and TCM. The educational process begins with the very first step where the student and the teacher now agree upon.

(b) the intersection is still zero, hence two steps must be undertaken: the teacher tries to reformulate the TCM taking into account the {MH + H} set he/she now has. The student tries to do the same with his/her {MH + H} concept map. After that, the teacher searches again for intersections between $\{MH + H\}_2$ and TCM_2

(c) the process goes back to (a) again, until a non-zero intersection arises. After a non-zero intersection is found between $\{MH+H\}_i$ and TCM_i at the i−th step of the process, a multistep connection between the original MH and TCM is done. The author would like to stress that this connection is now meaningful by construction since it has been built both by the teacher and the student, who has enlarged its MH step-by-step until getting in touch with the borders of the TCM, reshaped by the teacher. The topic to be taught should now make sense to him/her since it belongs to the stretched {MH+H}.

2.3 Observations

As side notes to the Learning Routes Method, we focus the attention on a number of points:

- the graph approach implemented via concept maps give almost immediately a quantitative analysis of the conceptual distance between the usual MH of the student and the TCM studied.
- MHs have to be periodically reshaped, especially for younger students, since their experience of the world may frequently undergo big changes and this implies careful changes in the teaching approach; of course, the MHs need not to be done again each time a new topic is to be taught
- it is here noteworthy that the proposed learning method addresses at least three out of four of the main characteristics listed by J. Bruner about a theory of instruction (ToI hereafter) (Bruner, 1966). They can be summarized here:

1. a ToI should say which *experiences* are more suitable to generate in a learner an attitude for learning, being it general or particular in nature
2. a ToI should specify the way a part of knowledge is to be *structured* such that it can be readily learned
3. a ToI should address the optimal *progression* to show the topic to be learned

Experiences refer to the MH, *structure* refers to the TCM and *progression* refers to the learning path. All these issues are addressed in this work.

3 Implementation

We propose here a summarizing chart where the method can be overviewed in its main steps:

1. starting internal condition of the learner: this is accomplished via the generation of a concept map of the MH of the student where his/her main personal characteristics are represented;
2. making the TCM of the topic to be taught: this TCM is better assigned to the teacher/educator, since it mirrors the way he/she sees the topic and so it will eventually highlight important differences between students' and teachers' way of thinking
3. searching for the conceptual route between MH+H and TCM via subsequent linked nodes (called NPL) eventually building a meaningful learning route.

An example of the implementation of the method is shown in figure 1: the *TCM* is illustrated by light orange blocks in the lower part: "circles, ellipsis ...", "strange curves", "lines", "cartesian plane", "many geometric objects". The *learning route* is illustrated by light green blocks in the middle: "cartesian geometry", "cartesian coordinates", "trajectories", "simulated routes on a field". The top of the figure is the *MH*.

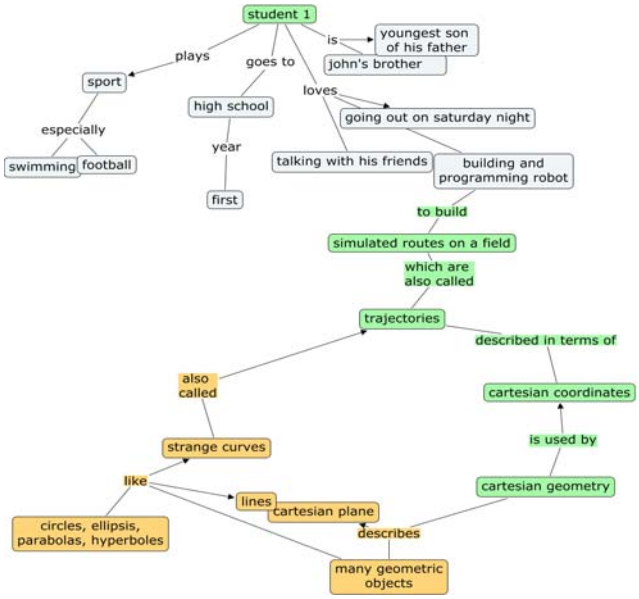

Figure 1. An example of the implementation of the Learning Routes Method.

4 Summary

This work shows a practical way to build a meaningful learning route between the internal world of a student and a topic to be taught by a teacher. This method tries to be an easy to implement way to link students' interests to fixed curriculum topics. This is a starting idea and a lot of work should be done:

- tests with a far larger number of students, in order to gain a better understanding of their learning differences and of their starting MHs
- tests in a variety of settings, like primary and secondary schools. It is advisable to test the method also outside schools, e.g. universities and beyond, especially the corporate sector.

5 References

Barringer, M. et al. (2010). Schools for All Kinds of Minds. Jossey-Bass.

Bruner, J. (1960). The Process of Education. Cambridge, MA: Harvard University Press.

Bruner, J. (1966). Toward a Theory of Instruction. Cambridge, MA: Belkapp Press.

Recommendation of the EU on key competences for lifelong learning (2006). Official Journal L 394.

Gardner, H. (1993). Frames of mind: The Theory of Multiple Intelligences. Basic Books, 10th edition.

Gardner, H. (1993). The unschooled mind. Basic Books.

Principles and Standards for School Mathematics (2000). NCTM.

Levine, M. (2002). A mind at a time. Simon & Schuster.

Levine, M. (2003). The Myth of Laziness. Simon & Schuster.

Levine, M. (2006). Ready or not, here life comes. Simon & Schuster, Inc.

Montessori, M. (1986). Discovery of the child. Ballantine Books.

Novak, J. D. (1986). A Theory of Education. Cornell University Press.

Novak, J. D., A. J. Cañas. (2006). The theory underlying concept maps and how to construct them. (Technical Report No. IHMC CmapTools 2006-01). Pensacola, FL: Institute for Human and Machine Cognition

Novak, J. D. (2010). Learning, Creating, and Using Knowledge: Concept Maps(tm) As Facilitative Tools in Schools and Corporations. Routledge.

Polya, G. (1981). Mathematical Discovery. Wiley - Combined edition.

Vygotsky, L. (1986). Thought and Language. The MIT Press; Revised edition.