NOTE ON COGNITIVE MAPPING IN THE TEACHING OF MANAGEMENT

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Abstract — Novak and Gowin’s cognitive mapping and Vee diagrams were introduced as a way of representing knowledge in two academic course settings — accounting and business strategy. The students produced two sets of maps and diagrams, one at the start of each course and one after completing them. The accounting course aimed at helping the students to elaborate and expand their knowledge structure, i.e. to assimilate the material delivered. The purpose of the business strategy course was to impose a specific type of knowledge structure on the students. Changes were more evident in the accounting case. The difference is discussed in light of Novak and Gowin’s distinction between education and rote learning. Suggestions for the further development and use of cognitive mapping in teaching are provided.

Key words: Academic education, cognition, cognitive mapping, course assessment, knowledge structure, methodological development, understanding.

INTRODUCTION

This article addresses the question of assessing academic courses in business. One way of improving the evaluation of effects and outcomes of courses is to use cognitive mapping, since this depicts thought structures and connections made between different concepts and principles. Students’ cognitive maps can be used not only for an assessment of their understanding, but also as an aid in developing and improving the courses.

COGNITIVE MAPPING

In a recent survey of cognitive mapping (Huff, 1990) a variety of choices and strategies are outlined. An implicit premise underlying Huff’s discussion appears to be that cognitive mapping is a specialized set of techniques, each requiring extensive training. This raises the question of whether a cognitive map should be seen as “a direct product of cognitive processes or as a tool to elucidate cognitive activity” (p. 405).

Our point of departure is to apply to the management field an approach which is closely related to the techniques treated by Huff but which stems from a different epistemological base [see Novak and Gowin (1984) and Novak (1993)]. Instead of regarding cognitive mapping as a set of techniques, we follow Kelly (1955) and look upon individual people as scientists with their own indigenous capacity for map making. Details of the structure, for instance the use of hierarchical representation, linear or circular causality etc., are thus not choices to be made by the researcher but implicitly by the “personal scientist”. Novak and Gowin (1984) stress the point that cogni-
Six maps can be drawn — after fairly limited general instruction — by practically anyone with some knowledge of a field. They provide detailed outlines for introducing concept maps, ranging from introductions suitable for first graders to college level.

The basic unit in a concept map is a proposition, which is essentially a sentence consisting of concepts and linking words. Concepts may be events or objects, and linking words any expression relating the concepts to one another. The following figure adapted from Novak and Gowin (p. 16) illustrates the idea of a concept map:

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WATER
made of changes
needed by
LIVING THINGS
MOLECULES
STATES
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The linking words may (but of course need not) represent causal relations. In the latter case it may be useful to introduce pointed arrows to indicate the flow of causality.

In any given field some concepts are more important than others. Novak and Gowin take for granted that meaningful learning proceeds most easily when new concepts are subsumed under broader, more inclusive concepts (p. 15), and recommend presenting such terms at the top of a causal map. The emphasis on hierarchical relations does not imply a strict tree representation as ideal. Cross links between different parts of a concept map may represent recognition of cross-territorialization between various fields of knowledge, and the number of cross links may serve as one index of “cognitive complexity”.

Novak and Gowin see maps which represent holistic understanding as the goal of education. This is contrasted with training, where the focus is on imposing separate pieces of knowledge on students, with little concern for interrelations between various subfields. In evaluating maps, Novak and Gowin emphasize the importance of structures in which certain concepts occupy a central position, as opposed to chain-like maps where bits are arbitrarily put together. It would be presumptuous to suggest an overall quantitative evaluative index, since this would imply knowing how knowledge should really be structured in any field. As possibly relevant “indices”, however, Novak and Gowin suggest: number of concepts, number of levels, number of connections and cross links, and they even indicate formulas for integrating such indices into an overall index, but this runs counter to their general qualitative emphasis.

In addition to concept maps, Novak and Gowin also discuss Vee diagrams (shaped like the letter V), which represent aspects of metaknowledge. The relevant objects and events in the given field are placed at the (bottom) point of the Vee. Questions dealing with methodological issues, including the justification of claims to knowledge — the “doing” part of knowledge production — are placed on the right branch. Questions dealing with principles and theories — the “thinking” part — are placed on the left branch. Figure 2 gives an example of a Vee diagram.

**METHOD**

The methods were applied in two different course settings. The university case concerned a 5-week full-time course in behavioural accounting, which put a broad emphasis on the multifaceted functions of accounting. The students were recently graduated MBAs (Masters of Business Administration) from the university. The college case concerned a 1-day teaching session on business strategy for undergraduate students during the third year of the MBA programme at the college.

In introducing concept mapping we used an excerpt from Macintosh (1985, p. 45), which deals with the reliability of expert statements. The use of material (reasonably) relevant to the specific course aims accords with Novak and Gowin’s recommendations. A group representation was compared with the authors’ map and Vee diagram, and the similarities and differences were critically discussed. This introduction of concept mapping took about an hour and a half. The students seemed to catch on to the idea of the concept map and the Vee diagram fairly well, and they did not seem to have any trouble in going on to produce their own maps of the course topics.

The students produced two maps, one at the start of each teaching course, and one just after its completion. In addition they were asked to write comments on their maps. Some students never produced the second map, but a comparison of their first maps with those of students who did produce both, reveals no noticeable differences in either of the cases.

The university case involved nine students who had majored in accounting (four of them interrupted their studies when they did not pass the first exam). The purpose of this course was to expand the students’ frames of reference and to improve their understanding of the broader context of accounting. The accounting courses for MBAs are comprehensive, with a special focus on the “instrumental” functions of accounting. This is described as the “model-based” view by Boland (1979) [cf. also single vs. double-loop learning (Argyris, 1988)]. Much weight is given to training in solving accounting problems, and these activities are seen as being normally performed within a “rational” decision-making-oriented frame of reference (Allison, 1971). In a few of the advanced courses in accounting modest efforts are made to link accounting to organizational issues. The students are not provided with any deep knowledge of behavioural accounting or of organizational theory as a basis for understanding management information systems (Hopwood, 1983). This makes the background similar to Novak and Gowin’s role-oriented “training” as against meaningful “education” (see Table 1).

The course was organized as a series of lectures and seminars around 12 themes referring to behavioural accounting, and emphasizing holistic aspects such as the social software of management information systems (Macintosh, 1985), accounting and the construction of the governable (Dermer and Lucas, 1986), the celebration of rationality (Boland and Pondy, 1983), organizational learning (Huber, 1991), the process of organizing (Hedberg and Jönsson, 1978, Feldman and March, 1981), and functions of accounting (Hayes, 1983).

The purpose of the lectures in the college case was to provide the students with a frame of reference for integrating theories and models with different paradigmatic bases. One idea was to use the superordinate character of business strategy as a device to improve students’ understanding.

<table>
<thead>
<tr>
<th>Table 1. Learning behavioural accounting: a two-aspect framework</th>
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<tr>
<td><strong>Reference</strong></td>
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<td>Boland (1979)</td>
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<td>Argyris (1988)</td>
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<td>Novak (1984)</td>
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of the relations between models and tools for business problem solving [see, for example, Dent (1985, 1990)].

Fifteen students participated in the 1-day session in the college case. The purpose of the map-making exercise was to design maps for factors influencing business profitability. Before the start of the business strategy section in the lectures, the students each designed a map 1. Only eight of the students subsequently sent in a map 2 within the time required.

Both researchers analysed the maps and the Vee diagrams to see how, and how far, they reflected the concepts, principles, models and theories presented in the teaching sessions. The resulting joint evaluation of the maps was presented to one of the students participating in the university case course, and he confirmed that the evaluations represented a fair view.

RESULTS

According to the maps, three of the five students in the university case significantly changed their understanding of accounting functions. Two of the students did not show any significant changes. Kate’s map will serve as a typical illustration of altered understanding (see Fig. 1).

The concepts in map 1 mainly reflect instrumental aspects which can be found in standard Swedish accounting textbooks. Map 2 shows a significant change. All the concepts in this map were discussed in some degree during the course. From her comments it is obvious that Kate is aware of the change in her cognitive structure. She makes explicit several links between accounting and organization theory that are crucial to a deeper understanding of the cultural and organization issues, e.g. the significance of information overload. There is also a notable development in Kate’s Vee diagram (see Fig. 2).

Objects are changed from ACCOUNTS (annual reports providing information) to ORGANIZATIONAL PHENOMENA (AS SHOWN BY RESEARCH). Vee diagram 2 clearly shows that Kate has extended her understanding of the functions of accounting from a purely instrumental and closed system view, to an open system outlook which contains explicit connections between accounting and the “social software” [cf. Macintosh (1985)].

Of the two students who did not show any significant change, one simply said that she had not changed her view, and she made her map 2 identical to map 1. The other just added some new concepts related to the course, but without making structural changes to the map.

Among the students who produced both maps in the college case, the influence of the “treatment” was less than in the university case. In most instances the changes in the maps can either be classified as being of minor importance to an understanding of the area concerned, or the relevance of the changes is unclear and does not justify any firm conclusions about the effects of the lectures.

As mentioned above, an important purpose of the lectures was to provide the students with a frame of reference enabling them to see the connections between different courses in the curriculum, and to link different theories and models in the MBA programme to each other. The model used is inspired by contingency theory (Dent, 1985), and a central feature is that profitability is presented as a hub in a network of mutually influencing factors (including environmental, strategic, control-oriented and internal factors).

Three of the students changed their maps, from presenting profitability as a concept at the top of the map to showing it as a “hub” concept. They also increased the number of links between profitability and other concepts, and the number of cross links between the concepts. For the other students no pronounced differences were found.
Schematically we can conceive two types of aims for teaching: to help the students to elaborate and expand their own structure, or to impose a specific type of knowledge structure on the students. In Piagetian terms, the first means the students assimilating material in order to expand their own structure, while the second means the students accommodating themselves to a given, imposed structure. In these terms our university case would exemplify the “expanding” pole, whereas the college case veers more towards the “imposing” pole. The first of these is more in line with Novak and Gowin’s general approach, and is clearly related to the Kellyan idea of “personal scientists” developing their own theories. Broadly speaking, the present results indicate that the first strategy was the most successful, since there were few significant changes in the college case.

This conclusion must be tempered by several factors. First of all, the university case lasted for 5 weeks, whereas the college case involved lectures and seminars during 1 day only. Furthermore, various aspects of the overall settings may have had an effect. Individual differences in cognitive style, for example, may be significant. Witkin (1969) makes a distinction between high and low analyticity. High analyticity may find it easier to map their thought structure than low analyticity, as they are better able to deal with parts of a perceptual field as distinct from the context. Perhaps a mapping procedure is easier for accounting students (high analyticity?) than for students studying strategy.

In the college case it was not possible to impose a predetermined frame of reference upon the students, as was attempted. One explanation could be that this was a result of stability in cognitive structures. It may take time to create or to change a frame of reference of the kind focused here. A set of lectures and discussions during one day may not be enough. Perhaps a certain “critical mass” is needed.

The students, especially in the university case, found the map drawing to be a very meaningful exercise. It should be emphasized, however, that a concept map ought not to be considered in isolation. In some cases it may be hard to interpret a map: does it show a deep understanding, or is it produced by rote processes? Supplementary information—through written comments, interviews and/or classroom activities—is needed to elucidate any lack of clarity and fuzzy details or reveal “pseudo-complexity” in the maps and diagrams. A map containing a large number of concepts may not always indicate true complexity, since several of the concepts may be related in a chain-like fashion and could be replaced by a much smaller number of concepts.

The students could use maps as a basis for the mutual elaboration of their perspectives. This may facilitate the development of the underlying cognitive structure. A study using repeated mapping—diagramming—interviewing exercises during a course could be interesting. It would offer opportunities for a step-wise tracing of cognitive development. Furthermore, the combination of mapping and clarifying procedures addresses in a novel way the question of interactive vs post hoc procedures in the elicitation of maps [cf. Huff (1990)].

The procedure for the demonstration of map making could be improved. Novak and Gowin talk about objects and events as examples of concepts to be used in the maps. We felt it was also important to include attributes such as strong, weak, formal and informal.

Teaching parallel groups of students can provide an opportunity for studying the effects of different teaching approaches and experimenting with different methods for evaluation and assessment. Using the approach in settings other than academic management education could be enlightening. An interesting experiment would be to compare groups of students in academic engineering and in business courses. It could be hypothesized that the proportion of high
analytics would be greater in the engineering student group than among the business students.

Since they promote self-reflection and learning, the method could prove useful as a device for clarifying and visualizing implicit ontological assumptions. Mapping and diagramming compel students — and teachers — to articulate presuppositions that are otherwise considered contextually self-evident. One way to expand inquiry in this direction would be to create composite maps and Vee diagrams, and to discuss these with the students.

Analytical approaches are related to "hard" data and quantitative measures, while a low analytic cognitive style is more in line with the use of soft information, such as visions, images and holistic impressions of the world. The hard–soft distinction may be significant if we are looking at specifically different types of decisions, and especially when it is possible to determine clear differences in the level of uncertainty. For a more general understanding of a field, the hard–soft dichotomy is not enough. Boland and Pondy (1983) examine the interplay between the use of hard and soft information. A further dimension may be necessary to describe and characterize the understanding of a field of interest in a more general way. We propose the employment of a "hot–cold" metaphor for this purpose. After immersing ourselves in the maps under discussion we felt we could say that some maps seem fairly ambiguous, and may leave the recipient "cold" — to adapt the Nisbett and Ross' (1980) distinction between "hot" and "cold" cognition. (This may of course be in the eye of the beholder. We cannot unequivocally conclude from such impressions that a detached, "cold", state of mind lies behind the map.) Other maps — representing the hot pole — may be clear, and depict an apparently more multifaceted thought structure, which also indicates a greater ability to see relationships between the concepts. Also, when the level of inclusiveness and differentiation is more balanced, it shows a feeling for perspective and altitude differences.

However, in this respect, cognitive maps produced by students are similar to maps produced by textbook authors and writers of scientific articles. We would claim that all kinds of maps are produced by similar cognitive processes, and share the quality that they may be (but certainly are not always!) very instructive and illuminating, although generally requiring further verbal elaboration for efficient communication.

A fruitful task for further inquiry would be to examine the features common to all maps, whether produced by "lay people" or "professionals". Organizing a field is a difficult undertaking, and "unaided" thinking a venture fraught with hazards.

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