An analysis, using concept mapping, of diabetic patients' knowledge, before and after patient education

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SUMMARY This study was designed to assess whether concept maps used with diabetic patients could describe their cognitive structure, before and after having followed an educational programme. Ten diabetic patients, in Paris and Geneva, were interviewed and, during the interviews, a concept map was drawn up by the researcher, using the patient’s words. This was done on three different occasions: the first day of the educational programme (Pre-evaluation), the last day (Post 1) of a week of education, then 3 to 4 months after education (Post 2). Twenty-eight maps were analysed, using a grid that quantified and qualified the knowledge expressed (knowledge categories, concept links, exactitude) and the organization of that knowledge (hierarchization of concept, cross-links). The examples shown in the maps of the 10 patients gave an illustration of how knowledge was developed or maintained with education, and also showed some learning difficulties encountered by the patients, the changes or preservation of their beliefs and the patients’ preoccupations. This study shows that concept maps can be a suitable technique to explore the type and organization of the patients’ prior knowledge and to visualize what they have learned after an educational programme.

Introduction

Therapeutic patient education requires the participants in the care process, the health professionals and the patients, to transform their respective roles and establish a real partnership (d’Ivernois & Gagnayre, 1995; WHO, 1998). If the educator must become a learning facilitator, then the patient must be considered an expert in his or her illness (Coulter, 1999). Even before a patient is educated, he or she has a considerable store of knowledge, perceptions, beliefs etc. about the disease, gained from events, from life experience and through information gathered from a variety of different sources. It is essential to have a better understanding of the patient’s expertise to create an effective partnership between care giver and care receiver and, consequently, to explore all forms of knowledge that the patient possesses from the time of the first contact throughout the entire process.

In addition, it is nowadays acknowledged that, if patients are to comply with treatment and live a healthy lifestyle, they need knowledge and understanding of the illness, although this is not yet sufficient (Brown, 1990; Coates & Boore, 1996). It seems pertinent, therefore, to conduct an investigation into how patient knowledge is created, structured and maintained in relation to therapeutic education.

However, although the usual evaluation tools employed by patient educators (open or closed questionnaires, case problem) will identify selective knowledge and the patient’s performance when faced with the task of solving a problem, they rarely measure the patient’s reasoning capacity (Cowen et al., 1988; Albano et al., 1998). In addition, none of these tools evaluates the way in which the patient’s knowledge is organized before patient education or the way in which patients integrate new information into their prior knowledge; these tools also do not really illustrate the patient’s beliefs.

This study looks at diabetic patients learning about their illness, at a time when recent cognitive psychology research has given us new ways to gain a deeper insight into information processing, memorizing and learning mechanisms, emphasizing the essential role played by previous knowledge (Ausubel, 1978; Gardner, 1993).

Concept mapping was proposed by Gowin & Novak in 1984 (Novak & Gowin, 1989), building on the theories concerning meaningful learning developed by Ausubel (1978). Concept mapping can be described as the cartography of an individual’s knowledge about a given theme (Wandersee, 1990): a group of concepts, organized and linked to form a complete, diagrammatic and hierarchical system. According to Gowin & Novak, concept maps are designed to improve student learning by giving it significance, as opposed to rote learning. When the student draws a concept map, he or she is able to demonstrate his or her mastery of all the constituent elements of a given theme. Concept maps are used in secondary education, mainly in the natural sciences, physics and biology (Stensvold & Wilson; 1990, Briscoe & Lamaster, 1991; Pinto & Zeitz, 1997). Several authors have suggested using concept maps to evaluate students, and have shown that they give more significant information about a student’s knowledge.

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and organization than most of the traditional evaluation tools (Rafferty & Fleschner, 1993; West et al., 2000). Consequently, we felt that an analysis of this method, as applied to patient education—exploring patients' prior knowledge and evaluating their acquired knowledge after education—would be relevant. Consequently, this research is an exploratory study to investigate the initial feasibility of such an approach. The study design is based on a pre- and post-evaluation of an educational programme. The post-evaluation is divided into two phases: post 1—immediately following the intervention, and post 2—a few months later. We will discuss the benefits offered by concept maps to explore the patient’s knowledge before education, to highlight the patient’s learning process and to show how patients reorganize their knowledge some time after attending an educational programme.

Research questions

We posed the following research questions:
1. Do concept maps identify and define patients' prior knowledge about their diabetes?
2. How do the patients’ maps develop after they have been educated, in the short term and in the long term?

Method

Sampling and research areas

Our study was carried out in two diabetic clinics, one in Paris (France) and one in Geneva (Switzerland). It involved 10 diabetic patients (four patients in Geneva and six in Paris), seven of whom had type 1 diabetes (IDDM) and three who were type 2 (NIDDM) diabetics. A priori, these patients had never attended an educational programme, such as those that are regularly organized by the diabetic services (5 days of education while admitted to hospital).

Procedure

In the clinics in Paris and Geneva, the study investigators selected patients who conformed to the criteria (no prior participation in a formal educational programme) and the study investigators informed these patients about the study protocol. All patients agreed to participate voluntarily in the study. The protocol consisted of a series of three recorded interviews of 30 minutes each with each of the patients, during which the interviewer produced concept maps. These interviews took place before the educational programme started (Pre-evaluation), on the last day of the educational programme (Post 1), and during an appointment that was scheduled for 3 to 4 months after the educational programme (Post 2). These were private interviews.

During Pre and Post 2 phases, the technique used was as follows (Figure 1):
- On a large sheet of paper put in front of the patient; there was a central concept: here, the word ‘sugar’.
- The interviewer then invited the patient to free-associate on the word, producing any words, ideas, etc. that the word suggested. The patient’s replies were transcribed into the map by the interviewer.
- The patient was then asked questions about the nature of the links between each of these words and the central concept. The explanations of the links suggested new concepts and new links to the patient; these were inscribed in the same way by the interviewer.

![Figure 1. Stages in drawing up a concept map during an interview.](image)
To help the patient clarify the concepts and concept links as much as possible, we used an interview method that was inspired by 'the explanatory interview technique' described by Vermersch (1996). This technique encourages the patient to clarify his or her knowledge by linking it as much as possible with the context (example of a question asked by the interviewer: You told me that hypoglycaemia is a lack of sugar; how do you know if you have a hypoglycaemia?). The concept map reproduces the patient's own words and the interviewer is not allowed at any time to make a judgement on the patient's discourse or to influence him or her with the interviewer's own knowledge. The interviews, recorded verbatim on a tape recorder, are done to complete the analysis of the maps.

On the last day of the educational programme (Post 1), the maps drawn up during the Pre phase were given to the patients again. Each patient was asked to reread his or her initial map and complete or alter the knowledge that had been conveyed several days earlier, taking into account everything that had been learned during the educational programme. Some 3 to 4 months later (Post 2), the patients were asked to produce a new map, without having access to the previous ones.

We obtained three concept maps per patient. The Post 1 map showed the alterations made by the patient to the map created in Pre evaluation: new knowledge was added, and other knowledge was deleted (see Figures 2, 3 and 4).

Analysis of the concept maps

We analysed 28 concept maps; two patients did not attend the Post 2 interviews. We did not take into account the objectives and educational programme content of diabetes units in Paris and Geneva in our analysis; nor did we compare the patients in Paris with those in Geneva. Finally, the analyses of the concept maps were not intended to establish a distinction between the type 1 diabetic patients and the type 2 diabetic patients, nor to take into account their age, their sex or the length of time for which they have suffered from diabetes.

Our analysis protocol for the concept maps had two sections. The first section assembled the data on the amount, nature and organization of the patients' knowledge. We will compare theses data at the Pre, Post 1 and Post 2 phases of the study. The second section was concerned with the source and the transformation of their knowledge in the three phases of the study. This analysis was supported by the patients' verbatim discourse, which was recorded during the interviews.

First part of the analysis. The following elements were taken into account:

(1) The number of knowledge units expressed in cognitive units (Brien, 1990). A cognitive unit is either a simple proposition (e.g. 'Hypoglycaemia is a lack of sugar') or a series of linked propositions (e.g. 'When you are hypoglycaemic you have to eat something to raise your sugar levels').

(2) Knowledge categories. We classed the knowledge in two groups, based on the categories defined in cognitive psychology (Brien, 1990, Tardif, 1992):

- declarative knowledge, factual, not directly linked contextually by the patient (e.g. 'Hypoglycaemia is a lack of sugar');
- other knowledge, linked contextually by the patient (e.g. the patient uses 'I', or 'Usually, I'), and/or elaborated in a way that produces reasoning or conditional actions (e.g. 'If (conditional) I eat fewer carbohydrates, I take (action) less insulin because (reason) there is a risk of hypoglycaemia').

(3) Nature of the links that connect the knowledge units. We classed the links connecting the concepts according to four groups:

- links of general expression: definitions, standards, associations, examples (e.g. 'Hypoglycaemia is a lack of sugar', 'Normal glycemia is 1 gram', 'Slow sugars such as pasta' etc.);
- cause and effect links ('Cause', 'Is due to' etc.);
- 'ways of behaving' links, describing preventive or therapeutic required behaviour ('I do', 'I check', 'I keep an eye on' etc.);
- links of personal expression: describing the personal ideas of a patient, such as opinions or emotions (e.g. 'It's not allowed', 'You have to', 'It's not nice', 'It frightens me' etc.).

(4) The validity, or the precision of the knowledge given by the patients about the concept maps, was examined by two independent experts in diabetology.

(5) The nature of the first concepts expressed by the patients. These first concepts can reveal the patient's preoccupations.

(6) The presence or absence of superordinate concepts or knowledge fields that related to them: according to Ausubel (1978), during the learning construction process, all new concepts will be incorporated into a larger concept, which he called a 'superordinate concept'. Superordinate concepts assemble and organize a large amount of knowledge; to identify these concepts in the patient's concept maps, we drew up a reference list of these concepts, using:

- the analysis of the principal learning domains in the educational programmes of the two diabetic units in the study;
- a survey (focus group) of 27 Swiss experts in diabetes education.

A synthesis of these two lists showed eight superordinate concepts that would normally feature prominently in the concept maps:

- diabetes
- hypoglycaemia
- hyperglycaemia treatment
- glycemia diet
- complication
- physical activity

These eight concepts were sought systematically in the three concept maps of each of the 10 patients.

(7) The presence of cross-links. These links connect the important knowledge fields (or superordinate concepts). They are, therefore, an important index of knowledge acquisition as, according to the 'integrative reconciliation' principle, a person's learning becomes significant when he/
she is able to recognize new relationships between the different concepts that have already been acquired [9].

Second part of the analysis. This part of the analysis was centred on the changes observed after the patient had completed the education programme:

- elaboration or persistence of partial knowledge;
- acquisition of a technical vocabulary (as used by the carers), and the possible problems of the patients integrating it into their own vocabulary;
- correction or persistence of inaccurate knowledge.

We have also tried to discover patients’ expressions related to the belief domain (in this study, this term is used to describe what the patient thinks or believes about something). We have checked the constancy or development of these beliefs across the three maps. We have also sought to evaluate how the personal experience of a patient can interfere with the integration of new knowledge from the educational programme. Finally, using the patients’ maps, we have sought to identify the knowledge fields that could show, by their importance, specificity and organization, or a particular preoccupation of the patient at a specific time in his or her life (for example: the knowledge domain linked to plans for getting pregnant, Figure 2).

Results

Patient characteristics

The study group consisted of 10 diabetic patients: seven type 1 diabetics and three type 2 diabetics—six women and four men. The average age of the patients was 43 years (range 21 to 62 years), and the length of time the patient had suffered from diabetes varied between 15 days and 20 years.

Nature and organization of knowledge

As shown in Table 1, the patients conveyed an average of 35.1 cognitive units in Preevaluation and added, on average, 24.8 in Post 1. The majority of knowledge units conveyed during these two phases were declarative. In Post 2, the total number of knowledge units conveyed was very slightly greater (on average, 43.3 cognitive units), but most of these knowledge units seemed to be linked to the patient’s context (on average 20.4, or 47%, in Post 2, as opposed to 10.2, or 29%, in Pre-evaluation).

The comparison of the types of concept links in the three study phases gave the following results:

- The percentage of links of a general expression decreased between Pre and Post 2 phases: from 33% (an average of 11.5 links in 35.1), to 27% (an average of 11.6 links in 43.3).

![Figure 2](image) Concept map obtained in Pre-evaluation for Subject 2 in the study.

*Note:* This map was drawn up using the concept ‘Sugar’.
The percentage of ‘cause and effect’ links increased between Pre and Post 2 phases: from 32% in Pre-evaluation (an average of 11.3 links in 35.1), to 35% in Post 2 (an average of 15.4 links in 43.3).

Although the average number of ‘ways to behave’ links increased between Pre and Post 2 phases, the percentage of this type of link remained constant at 29% (an average of 10.2 in Pre-evaluation and 12.5 in Post 2).

The links of personal opinions increased between Pre and Post 2 phases; however, these were a small number of links in the three phases of the study.

Generally, the diabetics experts found very few inaccurate knowledge units in the patients’ concept maps: an average of four (11%) inaccurate knowledge units per patient were discovered in Pre-evaluation; three inaccurate knowledge units (12%) were added, on average, by Post 1; and three inaccurate knowledge units, on average, per patient (7%) were identified in Post 2. Of the 42 inaccurate knowledge units conveyed in Pre-evaluation by all the patients, eight (or 19%) were maintained in Post 1. In Post 2, there were a total of 30 inaccurate knowledge units for all patients. Among these 30, some (two) that had been present in Pre-evaluation were corrected in Post 1 but are found to be exactly the same in Post 2.

The first concepts conveyed in the concept maps are primarily in the domain of nutrition (e.g. cooking, slow, fast, full of good things, lump, powder, sweetness, calorie etc.) and a knowledge domain relating to quality of life (e.g. life, not allowed, indispensable, weight, health etc.). The concepts hypoglycaemia and hyperglycaemia were most often the first expressed by patients but the concepts of treatment, glycaemia, complication and physical activity were very rarely—if ever—the first expressed by patients.

We found that the educational programmes give the patients the ability to acquire the superordinate concepts (or the knowledge domains that related to them). In Post 1, seven maps in 10 had all eight of the superordinate concepts expected, in comparison with four maps in 10 in Pre-evaluation. In Post 2, the eight superordinate concepts were found in five of eight maps (the complication concept was missing).

The patients seemed to have made connections in their knowledge just after and some time after the educational programme (Table 2). On average, 8.6 cross-links (between 2 and 14 links) were added between the superordinate concepts in Post 1. In Post 2, the average number of cross-links was 36.7, as opposed to 29.7 in Pre-evaluation.

### Table 1. Types of knowledge conveyed in the concept maps

<table>
<thead>
<tr>
<th>Knowledge categories</th>
<th>Declarative knowledge</th>
<th>Other knowledge</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRE-EVALUATION (n = 10 patients)</td>
<td>24.9 (71%)</td>
<td>10.2 (29%)</td>
<td>35.1 (100%)</td>
</tr>
<tr>
<td>POST 1 (n = 10 patients)</td>
<td>+16.4 (66%)</td>
<td>+8.4 (34%)</td>
<td>+24.8 (100%)</td>
</tr>
<tr>
<td>POST 2 (n = 8 patients)</td>
<td>22.9 (53%)</td>
<td>20.4 (47%)</td>
<td>43.3 (100%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Types of concept links</th>
<th>Links of general expression</th>
<th>Cause and effect links</th>
<th>Ways to behave links</th>
<th>Links of personal expression</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRE-EVALUATION (n = 10 patients)</td>
<td>11.5 (33%)</td>
<td>11.3 (32%)</td>
<td>10.2 (29%)</td>
<td>2.1 (6%)</td>
<td>35.1 (100%)</td>
</tr>
<tr>
<td>POST 1 (n = 10 patients)</td>
<td>+6.9 (28%)</td>
<td>+7.5 (30%)</td>
<td>+9.4 (38%)</td>
<td>+1 (4%)</td>
<td>+24.8 (100%)</td>
</tr>
<tr>
<td>POST 2 (n = 8 patients)</td>
<td>11.6 (27%)</td>
<td>15.4 (35%)</td>
<td>12.5 (29%)</td>
<td>6.9 (9%)</td>
<td>43.3 (100%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Validity of knowledge</th>
<th>Accurate knowledge</th>
<th>Inaccurate knowledge</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRE-EVALUATION (n = 10 patients)</td>
<td>31.1 (89%)</td>
<td>4 (11%)</td>
<td>35.1 (100%)</td>
</tr>
<tr>
<td>POST 1 (n = 10 patients)</td>
<td>+24.8 (88%)</td>
<td>+3 (12%)</td>
<td>+24.8 (100%)</td>
</tr>
<tr>
<td>POST 2 (n = 8 patients)</td>
<td>40.3 (93%)</td>
<td>3 (7%)</td>
<td>43.3 (100%)</td>
</tr>
</tbody>
</table>

Notes: The total corresponds to the average number of knowledge units or cognitive units identified in the patient’s concept maps. A cognitive unit corresponds either to a proposition (link between two concepts) or to a collection of propositions. The averages were calculated by adding the number of knowledge units or cognitive units identified in the patient concept maps and dividing them by the number of patients. The results presented are based on the average number of cognitive units obtained from one patient.
Source and conversion of knowledge

We have selected 41 examples (about four per patient) that illustrate the development of partial knowledge occurring in the concept maps from Pre-evaluation. Analysis of these showed that, in Post 1, these partial knowledge units were either roughly completed (21 examples), linked with other knowledge (14 examples) or were still held as partial knowledge (seven examples). In Post 2, although the cognitive elaboration phenomenon sometimes continued to be present (four examples), a change in the actual organization of the knowledge was noted in 16 examples (creation of cross-links). On the other hand, 10 examples of partial knowledge that were observed in Pre-evaluation were not found in the maps in Post 2. In nine other examples, the knowledge was maintained in a fragmentary state; in seven other examples, it was connected contextually by patients.

Eight patients showed the acquisition of medical vocabulary after education; six of them found difficulties in integrating these medical terms. For example, in his Post 1 map, subject 2 crossed out certain terms (slow sugar and fast sugar), replacing them with new terms (*hyperglycaemic sugar* and *hypoglycaemic sugar*), which were not used correctly and for which he was unable to give any examples (Figure 3). This subject found it very difficult to replace the knowledge acquired over the years (17 years of diabetes). In fact, in Post 2, the terms in Post 1 were not

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### Table 2. Organization of patient knowledge on the concept maps

<table>
<thead>
<tr>
<th>Organization of knowledge</th>
<th>Average number of cross-links</th>
<th>PRE-EVALUATION (first day of education) ((n = 10) patients)</th>
<th>POST 1 (last day of education: elements added to the Pre-evaluation map) ((n = 10) patients)</th>
<th>POST 2 (3–4 months after education) ((n = 8) patients)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-evaluation</td>
<td></td>
<td>29.7 +8.6</td>
<td>36.7</td>
<td></td>
</tr>
</tbody>
</table>

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*Note*: In this phase, the patient added and/or modified some knowledge after re-reading the map made in Pre-evaluation.
repeated. On the other hand, the terms previously employed in Pre-evaluation were linked wrongly (idea of equivalence); according to the patient, they could be substituted for ‘fast sugar’ (Figure 4).

We were able to observe that the patient’s preoccupations, i.e. the particular attention paid to a problem at a given moment in his or her life, had been modified by six patients in Post 2, which led to knowledge reorganization.

The patients’ beliefs were also modified some time after education: we identified six examples of positive or negative conversion of beliefs. However, in five examples, the patients still maintained beliefs that they had stated before education for 3 months afterwards. And in two examples, in Post 2, the patients returned to the initial beliefs that they had modified after education in Post 1.

The knowledge that the patients acquired by experience was studied in 17 examples found in their maps. In five cases (out of 17), the knowledge linked to experience was provisionally changed after education (Post 1), but was found to be intact some time after education (Post 2).

Finally, other complementary information found in the patients’ verbatim recordings was shown: the patients’ awareness of their misunderstanding and gaps in their knowledge, but also the learning that had been acquired during education, the ability of the patients to evaluate themselves and the degree of motivation to learn and to take responsibility for themselves.

**Discussion**

In our study, we wanted to show the impact of education, not on the changes in the patients’ behaviour but on the transformation of their knowledge systems. We decided that an analysis of the potential of an in-depth knowledge investigation tool—concept maps—would be an opposite method of doing this. Our objective was to use this technique to investigate the way in which these patients construct, organize and modify their knowledge from their preoccupations, experiences and beliefs, as well as according to the education they receive. This study combined the concept-mapping technique with the ‘explanatory interview technique’. By using careful, in-depth analysis of the maps and verbatim technique, patient by patient, we feel that a limited sample of patients is sufficient for qualitative research (Deslauriers, 1991).

**Exploration of prior knowledge**

Research in cognitive psychology has shown the importance of prior knowledge in the learning process. According to Ausubel (1978): ‘The most important single factor influencing learning is what the learner already knows: ascertain this, and teach him or her accordingly’. In patient education, several authors have delineated where it is essential to take into account prior knowledge before undertaking any educational programme (d’Ivernois &

![Figure 4](image). Concept map obtained in Post 2 for Subject 2 in the study.

*Note: This map was drawn up using the concept ‘Sugar’.*
Gagnayre, 1995; Lacroix & Assal, 2000). In particular, this must take into account inaccurate knowledge and beliefs, which could be obstacles to teaching scientific concepts. Other authors emphasize that if patients are to be recognized as experts, it is crucial to know what they themselves know about their illness (Coulter, 1990).

Educational diagnosis is frequently proposed for gathering information on the previous knowledge of patients; this is usually in the form of an open questionnaire, often completed using knowledge tests (Coates & Boore, 1996; Albano et al., 1998). Concept maps give a certain added value to these tests; in particular, an initial image can be obtained, a snapshot of the organization of the patient’s knowledge. They highlight the most important areas, the areas where the patient’s new knowledge will be constructed. This written evidence, mapped out from the patient’s own words, facilitates a quantitative and qualitative analysis. Using concept maps, one is able to distinguish between declarative knowledge, those beliefs or pieces of knowledge that have been constructed from experience, and knowledge deeply ingrained in the context of the patient’s life; the maps will also highlight under-elaborated (partial) knowledge. In addition, they help to highlight the links that the patient makes between his/her preoccupations, the context and his/her knowledge.

The learning process

Despite the inherent limits to the concept-mapping method (a diagram compiled by the interviewer, in a limited time, from the patient’s words), our experience has shown that concept maps give real information about the patient’s learning processes. In particular, it has been possible to visualize new knowledge acquisition added and linked to prior knowledge and, at the same time, to visualize patients in the process of deleting initial knowledge that they now consider to be inaccurate. Concerning the content of knowledge acquired (shown by the type of links), concepts maps show modifications in the patient’s representation of the disease (increased of ‘cause and effects’ links from Pre to Post 2 phases). The increase in ‘ways to behave’ links in Post 1 (38% of gain) give evidence of how the educational programme will develop the patient’s self-care capacities.

The concept maps also display the maintenance and disintegration of new learning, easy or difficult acquisition of technical vocabulary and, in particular, the primacy of the patient’s experience over the theoretical knowledge that he or she has been taught. We have been able to show that knowledge acquired by several patients through experience was replaced by new knowledge after education, but that the prior knowledge returned strongly several months after education. This observation could be an important point for educators, who should never underestimate the patient’s faith in the knowledge he or she has gained from personal experience. We observed that the amount of inaccurate knowledge was low and slightly different in Pre, Post 1 and Post 2 evaluation. However, the analysis of the development of inaccurate knowledge in patients is extremely interesting. In several cases the initial mistakes were maintained after education, showing a deficiency in educational programme; in other cases, they were eliminated by education, but reappeared some time afterwards. This type of situation is much more problematic, and suggests further possibilities for research, particularly to discover which factors encourage the return of inaccurate knowledge.

Finally, it should be pointed out that concept maps give a much more precise and comprehensible analysis of patient learning than a comparison of scores obtained from tests. As Wandersee (1990) pointed out, concept maps have many aspects in common with geographic maps: we are dealing with ‘cognitive geography’, where a patient’s quantitative and qualitative knowledge can be easily identified by a team of educators as it changes over time.

Knowledge reorganization after education

The fundamental problem in patient education is the longer-term maintenance and integration of knowledge. Most educators have noted that after education there is a loss of knowledge over time. This effect has been investigated by several researchers. Ebbinghaus, in 1885 (1994), had already shown that the amount of information forgotten is greater as more time elapses. More recently, Smith (1984) and Patel (1989) showed that long-term remembrance of knowledge is linked to use of that knowledge by the person in a familiar and relevant context. This means that knowledge that the patients have not applied regularly, or have applied in an unfamiliar context, will disappear more easily than knowledge that is more relevant. In this respect, our research confirms this principle. The concept maps showed clearly that all the patients had reorganized their knowledge some months after education. This was not a random reorganization, but one that made sense to each patient. On the one hand, we observed, in several patients, that declarative knowledge decreased over time (71% in Pre and 53% in Post 2) and other knowledge increased (29% in Pre and 47% in Post 2). This remark can be explained by the fact that theoretical (declarative) knowledge learned through the educational programme was ‘recontextualised’, i.e. integrated into their daily life. Our hypothesis is that declarative knowledge is transformed into contextualized knowledge as the result of patient’s appropriation process. Indeed, according to theories in cognitive psychology (Tardif, 1992), the learning process has an initial contextualization period (point of departure), then continues with decontextualization (understanding the rules), finally arriving at the recontextualization period (application of the rules in other contexts). This recontextualization is signalled, in particular, by appropriation within the vocabulary (the patient frequently uses the terms I, my, mine, for me etc.). On the other hand, in several cases, we showed that the patients reorganized their knowledge around superordinate concepts that were closely related to their main preoccupations at the time. These preoccupations could be: fear of hypoglycaemia, enjoying playing sports, whether or not to become pregnant, worrying about becoming fat, etc.

The patients’ ability to reorganize their knowledge and improve its contextualization seems to be predictive of real changes in behaviour related to the educational programme. In fact, it is difficult to imagine that a patient
who could not integrate his or her knowledge into daily life would be able to change his or her behaviour voluntarily. In a previous study (Bonnet et al., 2000), we showed that learning difficulties in patients could be linked to whether they could mobilize their knowledge in order to put it into practice. Under these conditions, it is possible that the patient’s capacity to recontextualize learning gained from education programmes is a predictive indicator of his or her ability to use it in a concrete manner. Concept maps like the ones we have used are a visible representation of this recontextualization. More research will be necessary to determine whether or not concept maps can identify patients at risk, i.e. those who, after education, have taken in very little knowledge and, consequently, have little chance of putting it to use.

Limits and perspectives

Concept maps have other advantages, which include making the patients aware of their metacognition. Several patients have told us that, as the concept maps were being drawn up in front of them, they had the impression that they could see all their knowledge and their reasoning.

Nevertheless, the authors are aware that this study has several limitations; in particular, the small number of patients included in the protocol reduces the degree of generalization possible. However, it should be reiterated that this research was qualitative. The technique we used also has constraints: the interviewer needed specific training before carrying out the explanatory questioning, and the length of the interview (about 30 minutes) caused problems for a number of the educators. Under these conditions, it is obvious that the conceptual mapping technique cannot be as immediately, widely and easily used by the teams as they might like.

The method for analysing the maps is based partly on methods suggested by several authors: valid links, levels of hierarchization (superordinate concepts) and of the degree of organization of knowledge (links between superordinate concepts) (Novak & Gowin, 1989; Wandersse, 1990). Previously, concept maps were mainly used in secondary and university education; using them in the context of patient education calls for a different analysis methodology, which concentrates on:

- specific knowledge categorization;
- observation of knowledge development, before, after and some time after the educational programme (partial knowledge, inaccurate knowledge and knowledge gained from experience);
- analysis of the relationship between the patients’ knowledge and its context in their lives (integration, recontextualization, organization relative to their preoccupations).

There is ample scope for other research to assess and improve this analysis method. In particular, if we think that a different researcher will obtain practically the same concept map based on the interview recording, the reliability of the results may depend on the analysis: the knowledge categories could be discussed as well as the researcher influence.

Conclusion

Knowledge acquisition is a fundamental problem in patient education. Our research concentrated on the learning process and results in diabetic patients. The concept mapping technique, proposed in 1984 by Gowin & Novak (Novak & Gowin, 1989), is beginning to become widespread, both as a means of evaluating students and, especially, as a learning aid. Our original approach, using concept mapping in the field of patient education, with maps being made during a patient interview, seems promising: the patients’ prior knowledge can be explored, and their learning evaluated. Concept mapping reveals elements that are normally explored separately: knowledge, ideas, representation, reasoning and courses of action. Such maps show how scientific facts, layman’s knowledge and beliefs, as well as the patient’s emotions, are linked together in the patient’s cognitive structure.

This study opens new research perspectives concerning the relationship between knowledge acquired from education and changes in health behaviour. It would thus be significant to analyse, using concept maps, the relationship between knowledge appropriation by the patients and real change in their day-to-day behaviour. Concept maps could also give a better understanding of the reasons why patients persist in holding inaccurate ideas, despite being educated to the contrary. From this point of view, the authors believe that the concept-mapping technique has a real place in the panoply of patient teaching instruments and methods. In our opinion, it is essentially a diagnostic technique, which educators can use to identify patients’ prior knowledge, to decide upon knowledge requirements and to distinguish learning dysfunction more effectively.

References


