Design of a teaching/learning sequence on the concept of balanced diet and healthy eating

Introduction

There is an increasing attempt to match teaching methodology with concepts in biology, resulting in a re-appraisal and re-orientation of science instructional objectives and classroom teaching methods in the schools (Telu, 1999). This study focuses on the confusion and misconceptions relating to the nature and functions of the classes of food and the inability to apply some basic knowledge of scientific terminology to higher order thinking (Lakin, 2004). For example, several students adopted the mathematical and scientific approach to the concept of 'balanced diet' – balanced meaning equal – and also on the role of protein in diet – as a primary source of energy and reflected this in their diet (Lakin, 2002). This over representation has been recognised by Kilborn and Brown (2001) in their study on children's packed lunches; it was discovered that children were eating too much protein in their diet on a regular basis. Bullen and Benton, (2004) also found out that students lack practical skills and procedural dietary knowledge.

This paper is a part of a larger research project investigating the relationship that exists between teaching method and students' conceptual understanding and practical skills acquisition of balanced diet and healthy eating concepts.

■ *Language*

In this research students are introduced to new ways of thinking and talking about healthy eating. The teacher has the role of introducing the new social language and guiding the students towards a capacity to use the new language independently. The Vygotskian notion of 'internalisation' is drawn on to account for how students' existing knowledge interacts with new knowledge introduced on the social plane of the classroom, influencing the ways in which students make sense of and become able to appropriate that knowledge for personal use. The teacher has the dual role of introducing the social language of school science to students, and assisting students' performance in becoming able to use that social language independently through internalisation. Vygotsky (1978) saw knowledge construction as an on-going, zigzag process in which the child, in collaboration with the teacher or other children, integrates everyday concepts into a system of related concepts and transforms the raw materials of experience into a coherent system.

Designing a teaching/learning sequence is a complex activity that necessitates taking into account the classical three poles – knowledge, learning, and teaching – without forgetting the institution in which the teaching and learning activities take place and the artefacts by which the activities are mediated. Each pole can be linked to a root domain of theoretical framework: epistemology, psychology and didactics.

Pre-construction phase

Lijnse (2000) proposed a 'problem-solving approach' grounded on three main hypotheses:

■ Teaching/learning sequence can use different fundamental hypotheses, depending on the relation between the knowledge to be taught in the sequence and the set of a *prior* idea that common life leads each individual to form and, thus, depending on the phenomenological domain, the learning of which is expected.

■ The design of a teaching/learning sequence not only depends on the knowledge to be taught, but also on the particular educational system in which it is carried out.

■ He also claimed that motivation is a prime aspect of the design of a sequence.

Based on the these three hypotheses, and for each sequence of a given domain, Lijnse elaborated 'didactical structures', horizontally organised in three levels – the content level, the motivational level and the reflexive level – between which the sequence progress switches, going from an initial questioning to a deeper understanding of the issue.

Kortland (2001), cited in Buty, Tiberghien and Le Marechal (2004), refined Lijnse's didactical structure by distinguishing five phases: motivation, question, investigation, application and reflection.

■ *Conceptual change*

Meheut (1997), describing the learning hypotheses underlying the construction of a teaching sequence about the thermo elastic properties of gases, hypothesised that *'a model can be accepted by pupils only if it seems to be "better" tool for explaining or predicting phenomena'*. This represents a particular version of a more global assertion of Posner et al (1982) about conceptual change. In their conceptual change model, student dissatisfaction with a prior conception was believed to initiate dramatic or revolutionary conceptual change and was embedded in radical constructivist epistemological views with an emphasis on the individual's conceptions and his/her conceptual development. If the learner was dissatisfied with his/her prior conception and an available replacement conception was intelligible, plausible and/or fruitful, accom-

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modation of the new conception may follow. An intelligible conception is sensible if it is non-contradictory and its meaning is understood by the student; plausible means that in addition to the student knowing what the conception means, he/she finds the conception believable; and the conception is fruitful if it helps the learner solve other problems or suggests new research directions.

■ *Learning demand*

Leach and Scott (2002) offered a perspective for constructing teaching sequences, *'based on the concept of learning demand and a social constructivist perspective of learning'*. They claimed that considering the effectiveness of the sequence of teaching tasks upon learning is not enough. The teacher's role in staging those teaching tasks should also be considered. In particular, every improvement in the teacher's understanding of the sequence, for example after discussion with the researcher, is likely to have consequences on the level of his/her engagement and the effectiveness of learning in the classroom.

Consequently, their approach for developing teaching/learning sequence includes:

1. Identification of the school science knowledge to be taught;
2. Consideration of how this area of science is conceptualised in the everyday social language of students. At this step, the alternative conceptions, or everyday reasoning, which have been identified by research literatures, must be used;
3. Identification of the learning demand by considering the differences between the two first points; and
4. Development of a teaching/learning sequence.

The conclusions drawn from these studies consist of:

■ Grounding the design of teaching/learning sequence on a well-structured theoretical framework, including learning hypotheses taking into account initial conceptions of students;
■ Narrowing the distance between students' initial knowledge in relation to the zone of proximal development – that is the 'distance' that the learner must travel between his/her initial knowledge and the knowledge to be taught; and
■ Recognising the critical role of the teacher in the teaching/learning sequence.

Construction phase

This phase expatiates on the social constructivist and educational reconstruction theories that underpin the design of the teaching/learning sequence on the concept of balanced diet and healthy eating.

A combination of the social constructivist perspective and the educational reconstruction theory brings to the fore the notion that some parts of students' initial conceptions have a more important role than others in the students' conceptions of the material to be learn. The learner is then supposed to develop new knowledge from some facets of his/her initial knowledge without too many difficulties, because they are not in contradiction with the new knowledge.

■ *Hypothesis on knowledge*

The theoretical position of knowledge based on Chevallard (1991) as cited in Buty, Tiberghien and Le Marechal (2004) is that knowledge 'lives' within groups of people called institutions and the relation between an individual and a piece of knowledge is termed 'understanding of knowledge'.

The designer may reorganise the curriculum, decompose it into smaller pieces and integrate it into activities. In this case, the concept of balanced diet and healthy eating was broken down into classes of food, functions of the classes of food, examples of food items of the different classes of food, and composition of the different classes of food to form a balance meal using a food photo album as a model.

The difference between students' own ideas of food classes and their functions, compositions of a balance diet and examples of food items corresponding to the different classes of food and those of school science were the key elements in the development of the teaching/learning sequence.

Young children have acquired a common-sense understanding of their immediate environment and its phenomena, based on their experiences of everyday routines. As these experiences are often embedded in culture (Hallden, 1999) and are emotionally stimulated (Pintrich et al, 1993), the older children become the more complex the process of change becomes. Recent learning theories see this process as one of construction and is the reason why this study involves pupils aged 11–12 years.

■ *Zone of proximal development*

The 'distance' that the learner must travel between his/her initial knowledge and the knowledge to be taught (zone of proximal development – ZPD) is analysed in terms of general questions such as: is this 'distance' planned for the teaching activity within the ZPD? This composition is similar to the learning demand proposed by Leach and Scott (2002). It might be suggested that some parts of students' initial conceptions have a more important role than others in the construction of

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concepts. This has implications for the order of presentation of concepts in the teaching/learning sequence. The approach thus requires that a teaching sequence on a new domain originates with everyday notions, even if this changes the usual rational order of the introduction of the concept.

The careful examination of initial knowledge is a powerful aid in making explicit aspects of knowledge that are usually considered obvious by teachers, but are not known by some students so making their subsequent learning poorly founded. Also, in the social constructivist approach, the mediation through language leads to consideration that verbal interactions, between students and between students and teachers, favour the development of the meaning of knowledge and of the meta-knowledge like judgement and other control processes involved in the teaching situation.

■ *Role of the teacher*

Depending on interactions, the teacher plays several roles: besides the role of managing the class, he/she is a tutor of students and a mediator between the world of scientific knowledge and practices, on one hand, and the students, on the other (Buty et al, 2004). As a tutor, he/she has not only the duty to help students when they encounter difficulties they are not able to solve alone, but also to avoid giving the solution to problems before students can try to solve them. As a mediator, the teacher has to give a scientifically appropriate linguistic expression to the knowledge, but at the same time he/she must use a language that students can understand.

More so, a significant proportion of the teaching time should involve work in small groups in which the management is mainly up to the students. This is referred to as devolution which is the act by which the teacher makes the students take responsibility for a learning situation or problem, and accepts the consequences of this transfer him/herself (Brousseau, 1998, cited in Buty et al, 2004).

As already stated, the path from theoretical framework to the design of a sequence is more than a rational deduction; it also requires the designer to make choices based on teaching practice such as estimating the duration of a task and putting together several hypotheses to design the structure of the sequence.

The structuring table (see Table 1) integrates the hypotheses of knowledge and on the role of initial students' knowledge in relation to the zone of proximal development. It allows the designer to analyse and decompose both the knowledge to be taught and the students' knowledge, and to compare and evaluation them.

It helps to appreciate the notion of distance between the knowledge to be taught and the students' knowledge. On the basis of this structuring table, this comparison is done according to the two dimensions of knowledge analysis: the everyday knowledge and the scientific knowledge, on one hand, and the modelling levels on the other (Table 1).

	Already known in nutrition (taking into consideration the curriculum of previous classes)	Already known from everyday life	To be constructed (nutrition)
Theory/model	**Body needs food**	**Food items**	**Classes of food**
Relation between theory/model and objects/events	Examples of food items	Food is good for you	Group food items into carbohydrates, proteins, etc
Objects/events		Familiarity with some of the food items	Reasons for classifications

Table 1
Using the Structuring Table to Design a Teaching/Learning Sequence on Classification of Food.

In each cell of the structuring table are indicated the pieces of knowledge involved in the task or in the sequence. In a row, every piece of knowledge is classified according to the modelling levels: these refer to the level of ideas, to the one of material world or make a link between these two levels. In the columns, pieces of knowledge are classified according to learning processes: they can belong to previous knowledge, either from previous instruction or everyday life; they can also have to be constructed during the teaching sequence or session.

The above table will help to 'sequentialise' the knowledge to be taught according to the time allowed. It also allows for the specification of the type of modelling processes that are expected from students during the task, and which part of their previous knowledge is used to construct new meanings.

■ *Educational reconstruction*

The structuring table above is also based on the model of 'educational reconstruction' developed by Kattman et al (1995). The significant feature of

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the educational reconstruction approach is that its analysis of science content takes into account not only epistemic dimensions, but also context, applications, and ethical and social implications. Students conceptions are taken into account in a constructive perspective in reconstructing science content structure by providing answers to questions like: Which are the most relevant elements of the students' conceptual framework to be respected? Which opportunities are opened by certain elements of students' conceptions or perspectives? Which conceptions of students correspond with scientific concepts in such a way that they can be used for a more adequate and fruitful learning?

Results of the analysis of content structure (linking clarification of the core concepts of analysis of the educational significance) and preliminary ideas about the construction of instruction play an important role in planning empirical studies on teaching and learning.

Conclusion

This design has broadened out the 'personal constructivist perspective of learning' (patterns in the ideas held by individual learners), within a broader view of learning which places more emphasis on the socio-cultural aspects of teaching. Classroom interaction among students and between students and teacher and prior knowledge and the knowledge to be taught were all taken into account in the design. Less emphasis was placed on the individual and more on the learning context and the communities of practice, with the teacher's role being on of supporting pupils by making the practices of the scientific community meaningful at the individual level.

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