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Chapter 4

Using goal systems to make sense of biology teachers’ interpretation and implementation of a context-based reform

This chapter is based upon:
Abstract

Teachers simultaneously have to meet many diverse goals when planning and teaching lessons. A so-called goal system can be used to represent the hierarchical relationships between teachers' goals and teaching practice. The aim of this study is to explore how goal systems can be used to understand how individual teachers interpret and implement a new, innovative curriculum. Our study is based on twelve biology teachers who participated in a professional development program to design and use context-based lessons. During an initial interview each teacher's goal system was mapped out using the technique of laddering. Subsequently, during the professional development program, interviews, lesson plans and thinking aloud protocols were used to gain insight into teachers' interpretation and implementation of this educational innovation. We found that within a goal system, teachers' core goals – which are defined as goals with two or more links to either higher or lower ranking goals – strongly influenced teachers' interpretation and implementation. To a slightly lesser extent, negative links – i.e. goals that obstruct or contradict each other- also influenced appeared relevant.
4.1 Introduction

Recently, the Dutch secondary school science curricula have been updated. This reform was inspired by a context-based approach (Boersma et al, 2008) with the aim of becoming more relevant, up to date and coherent. How this innovation is actually implemented in the classroom depends on how teachers design and teach their lessons (Dam, Janssen, & Van Driel, 2013). In general, educational reform is mainly targeted at student learning. However, teachers who design and teach lessons simultaneously have to meet many diverse goals (Doyle & Ponder, 1977; Kennedy, 2002, 2006). Kennedy (2002) found these goals reflect into six areas of concern for teachers: sustaining the flow of the lesson, increasing learners’ motivation, teaching the required content, fostering learning, running a well-managed classroom and meeting the teacher’s own cognitive and emotional needs. All these areas of special interest come into play when teachers teach a new curriculum, irrespective of whether they make use of ready-made teaching materials or design their own (Davis, Beyer, Forbes, & Stevens, 2011).

It is not yet clear how all these varied goals influence teachers during lesson preparation and execution. We do know, that interviews with teachers about their practice usually do not bring this whole range of considerations to light and also that the relationship is not one on one between what teachers say they want to achieve and their actions (Cochran-Smith & Lytle, 1999; Cohen, 1990; Kang & Wallace, 2004; Mathijsen, 2007). Videotaping of lessons with follow-up questioning about the teacher’s decisions has been used in an attempt to gain a better understanding of teachers’ goals and practices (Kennedy, 2002; Schoenfeld, 2010). However, this is a time-consuming method which, although it provides a wealth of information about one or a small number of lessons, does not easily allow us to ascertain which of the teachers’ goals will actually come into play during the implementation of an innovation.

Psychology has a long tradition of conceptualizing peoples’ goals, and also of relating those goals to their conscious or unconscious decisions, for example when making choices about staying in a relationship, choosing a product from the supermarket shelves or while planning lessons (Austin & Vancouver, 1996). It appears that peoples’ goals are organised within a hierarchical system. Someone who works out in a gym three times a week might, for example, do so to improve their physical condition, enhance their physique and to meet other people as well. The goal of an improved physique is subordinate to higher level goals such a healthier and longer life. Goals such as looking more attractive and meeting new people are goals which can also be subordinate to alternative higher-level goals (Carver & Scheier, 2001).

This study aims to research if goal systems, based on teachers’ individual knowledge and experience, can clarify their understanding and implementation of an innovative
context-based curriculum. This research was carried out during a professional development program which aimed to support biology teachers in their design of context-based lessons for their own classroom practice.

### 4.2 Theoretical framework

The main inspiration for the use of hierarchical goal systems comes from Carver and Scheier (2001), who again refer to back to Powers’ (1973) control-system theory. A goal system consists of different levels of goals: high, intermediate and low. Goals at the highest level usually refer to fundamental aspects of personality, such as being a good, nice or successful person. Intermediate level goals often refer to actions a person must take to achieve those higher goals, such as spending more time with their children in order to be a ‘better’ parent. Goals at the lowest level describe how such an intermediate level goal can be reach (reading a story to my children every night). Lowest level goals can take the form of scripts, a series of actions to be performed in a certain order.

Goal systems usually refer to positive goals, i.e. goals someone wishes to achieve. However, negative goals, i.e. things to avoid, can also be part of a goal system (Carver & Scheier, 2001). A child for example may want to go straight home after school to avoid being punished for tardiness by his/her parents. Goals can also be positively related with one aspect and negatively related with another, for example working out at the gym can improve fitness and physical appearance on the one hand, but time-consuming workouts can correlate negatively with the wish to spend more time with the children reading bedtime stories and thus being a better parent.

The possibilities goal systems offer to comprehend how teachers’ goals relate to their actual teaching have, until recently, received little attention and research. Janssen et al. (2013) have demonstrated that a teacher's goals system does indeed seem to influence their classroom practice. They also present a method to increase the perceived congruence between a reform ideal and a teacher’s goal system, thereby increasing the likelihood of their adopting an innovative method of teaching.

In this study we aim to research in which way or ways a goal system can be used to explain and comprehend individual teachers' understanding and implementation of an innovative curriculum. It is to be expected that some goals are more important than others. Ford (1992) stated that the most influential and motivating goals are those that have the most links to other goals and that these well-linked goals are more resistant to change compared to goals with fewer links. Kruglanski et al. (2013; 2011) have further developed this idea. They describe two variants, the first of which is equifinality. Equifinal goals are ends that can be achieved through different means. For example, to lose weight someone
can work out three times a week, cut out high-calorie foods and ask their partner to remind them of their resolutions. The second variant is multifinality, in which one means can serve different higher-level goals. To return to the example, someone who wishes to lose weight can do so to fit a certain summer dress, to look better and to improve his or her health. Kruglanski et al. (2013) state that people value multifinal and equifinal goals, that is, those which are either linked to multiple higher or lower level goals, higher then goals that are less connected to other goals.

Based on the above, a number of hypotheses can be formulated concerning the relationship between a goals system and the implementation of an educational innovation. Firstly, we expect equifinal and multifinal goals – goals which are more highly linked to other higher or lower level goals – to have the most influence on how a teacher interprets an innovation. We shall refer to these goals as core goals. Secondly, we expect that not only positive, but also negative links in teachers’ existing goals systems are of influence on their interpretation of the innovation. Negative links presumably cause conflict in a teacher’s existing practice. To resolve this conflict a teacher could cherry-pick those innovative elements that fit easily into their existing goals system and teaching practice.

4.3 Methods

4.3.1 Context
This research was carried out in the context of a professional development program designed to help teachers to develop innovative context-based biology lessons. Dutch biology teaching is undergoing a reform, the aim of which is to make biology education more relevant, more up to date and more coherent. To meet these ends, learners need to learn to apply concepts within relevant contexts. In this new curriculum contexts are defined as authentic practices, in which participants carry out certain activities with the aim of meeting goals which are relevant within this practice. Examples of contexts are, for example, the stewardship of a nature reserve; food production; or forensic research (Boersma, Kamp, Van den Oever, & Schalk, 2010). The new curriculum does not specify a way of teaching, i.e. pedagogy, but encourages teachers to (re)design their lessons according to the concept-context approach. The professional development sessions in this research were based on, firstly, a pedagogical framework, which incorporates the innovation principles as described by Boersma et al. (2010), and, secondly, on the experiences of teachers who participated in curriculum development schools (in Dutch: Biologie Ontwikkel Scholen) and whose input influenced the finalized curriculum.

The professional development program was conducted by two teacher educators, one of whom had been a member of the curriculum commission CVBO (In Dutch: Commissie
Vernieuwing Biologie Onderwijs). During the program, participants designed and taught short lesson series based on the new context-based curriculum. They met up with the two teacher educators during five sessions to discuss the new curriculum, to analyse existing examples of context-based lessons and to receive, on a need-to-know basis, specifically designed tools to allow them to design their own context-based lessons. Both the teacher educators and participating teachers themselves presented examples of context-based lessons or series of lessons. During the sessions, participants were encouraged to make use of the available expertise and were given the hands-on opportunity to design context-based lessons and to reflect on their teaching experiences.

Table 4.1 Characteristics and objectives of context-based lessons

<table>
<thead>
<tr>
<th>Lesson characteristics</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Start with a vivid introduction on the context that ensures students imagine themselves being part of the context and that activates prior knowledge (A,B,C)</td>
<td>A. Students' prior knowledge is activated.</td>
</tr>
<tr>
<td>2. The context is a concrete situation from students' life worlds or from professional or scientific practices (C, D,E,F,G)</td>
<td>B. Students feel involved and focused.</td>
</tr>
<tr>
<td>3. Within the context multiple biological concepts from different biological domains come together (G)</td>
<td>C. Students feel motivated to learn biology.</td>
</tr>
<tr>
<td>4. The teaching unit has a guiding question, which provides a clearly focused problem orientation (H,I)</td>
<td>D. The concepts have relevance within the context.</td>
</tr>
<tr>
<td>5. The student activities match the context and guiding question (F,I)</td>
<td>E. The concepts derive their meaning from the context; students learn to understand the importance of biological knowledge within this particular context.</td>
</tr>
<tr>
<td>6. Students learn to use key concepts of biology (J)</td>
<td>F. Students learn to develop specific biological skills.</td>
</tr>
<tr>
<td>7. Students are stimulated to reflect upon their learning process, their understanding of the biological concepts and the relation between the concepts (G,J)</td>
<td>G. Students learn to understand how different biological concepts are related.</td>
</tr>
<tr>
<td>8. Students are presented with multiple contexts in which the same concepts are used (E,J)</td>
<td>H. Students feel a &quot;need-to-know&quot;.</td>
</tr>
<tr>
<td></td>
<td>I. The teaching unit is coherent.</td>
</tr>
<tr>
<td></td>
<td>J. Students work on a thorough understanding of biological concepts and are able to use these concepts within a diversity of contexts.</td>
</tr>
</tbody>
</table>

Note The objectives as they have been defined in the right column are in most cases not only objectives, but also means towards higher goals such as conceptual understanding (J). In the PD program, a chart has been used in which the hierarchical relationships between these means and goals had been visualized.
4.3.2 Participants

Fifteen biology teachers from five different schools participated to the program (table 4.2). All had responded to an advert in a national journal for teachers or an email sent to secondary schools in the province of Zuid-Holland. Participants came from schools in Zuid-Holland, Utrecht and Brabant. Three teachers discontinued the program for personal reasons and have been discounted in this research. The results from all twelve remaining participants have been analysed. Due to lack of space, we chose to mainly focus our report on the development of three of them: William, Marion and Nicoline. These three teachers were chosen because they show a wide range of variation in terms of the content of their goals and the nature of the relationships between their goals and their implementation of the new biology curriculum.

<table>
<thead>
<tr>
<th>Teacher</th>
<th>School</th>
<th>Predominantly teaches in grades…</th>
<th>Teaching Experience [years]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingrid*</td>
<td>A</td>
<td>1-6 pu/gs</td>
<td>20</td>
</tr>
<tr>
<td>Nicoline</td>
<td>A</td>
<td>4-6 pu</td>
<td>23</td>
</tr>
<tr>
<td>Jacqueline</td>
<td>B</td>
<td>4-6 pu</td>
<td>3</td>
</tr>
<tr>
<td>Norbert</td>
<td>C</td>
<td>4-6 pu/gs</td>
<td>11</td>
</tr>
<tr>
<td>Steven</td>
<td>C</td>
<td>1-3 pu/gs</td>
<td>5</td>
</tr>
<tr>
<td>Simone</td>
<td>C</td>
<td>1-3 pu/gs</td>
<td>20</td>
</tr>
<tr>
<td>Ben</td>
<td>C</td>
<td>4-6 pu/gs</td>
<td>3</td>
</tr>
<tr>
<td>Roger</td>
<td>C</td>
<td>4-6 gs</td>
<td>34</td>
</tr>
<tr>
<td>Elizabeth</td>
<td>C</td>
<td>4-6 pu</td>
<td>30</td>
</tr>
<tr>
<td>Marion</td>
<td>D</td>
<td>4-6 gs</td>
<td>15</td>
</tr>
<tr>
<td>Oliver</td>
<td>E</td>
<td>4-6 pu/gs</td>
<td>9</td>
</tr>
<tr>
<td>William</td>
<td>E</td>
<td>4-6 pu/gs</td>
<td>31</td>
</tr>
</tbody>
</table>

* Pseudonyms have been used to ensure anonymity
** Grade 1 is the first grade of secondary school, comparable to grade 7 of the English/American system. Average age of pupils is 12/13. pu = pre-university; gs = general secondary education. No pre-vocational education teacher participated in the study.

4.3.3 Data collection and analysis

As an initial step, the goal system of each teacher was constructed during a laddering interview. This interview technique has been commonly used to decipher and elucidate goals and their hierarchical relationships (Fransella, 2005; Grunert & Grunert, 1995; Reynolds & Gutman, 1988). During such an interview, the interviewee is continually asked the following two types of questions: ‘why do you do that?’, and ‘why do you think that that is important?’ on the one hand, and ‘how do you do that exactly?’ on the other. The merits and use of this technique to elucidate teachers’ goals systems has been described in detail by Janssen et al. (2013). During the intake interview, participants were requested to describe one of
their recent lessons and to use this lesson to characterize their regular teaching practice. Then, teachers were asked to describe more in detail how they commonly approach certain aspects, such as explaining new content, and why. Each goal a teacher mentioned was written down straight away, and the reasoning behind the goal was unpacked using follow-up questions until no more new information could be extracted. Because goal systems are context-dependant, each teacher was asked to focus on one class or level of learners during the whole professional development program, and to have a ‘regular’ lesson in this class in mind during the interview. During the interview the hierarchy of goals that make up the goal system was constructed graphically. The annotation of the goals and of their relationships was written down in the teachers’ own words. No later adaptations or changes were made to these goal systems, except for some considerations of layout to improve legibility. Teachers were immediately asked to comment on the resulting goal system and were asked questions such as: ‘do you think this goal system matches what you really think and do in this class?’; ‘is there anything you would wish to add?’; ‘do you think this goal system also applies to lessons about other topics in this class? And if so: why or why not?’; ‘are certain goals more important than others?’; ‘are certain goals easier to achieve than other goals?’; and also: ‘what prevents you from reaching certain goals?’; ‘do some goals contradict others and if so, how?’ All in all, each interview lasted about one and a half hours. Afterwards the first author marked the central (multifinal and equifinal) goals in the system. Core goals were defined as goals linked to two or more other goals at a higher level (multifinal goals; Kruglanski et al. (2013)) or to two or more lower level goals (equifinal goals; Kruglanski et al. (2011)).

To gain insight into the way in which each participating teacher understood and implemented the new curriculum their lesson plans, assignments and videos of their lessons were collected both during and after the professional development program. Teachers’ discussions during meetings were taped and during the fourth session an audiotape was made of each teacher thinking aloud during the process of designing a lesson. Shortly after this meeting, teachers were approached by telephone for individual interviews. Four to five months after the end of the professional development program, each teacher received a school visit and final interview, to discuss changes in their thinking and teaching and to allow them to reflect on the professional development program, the new curriculum and their personal goal system.

All discussions, interviews and thinking-aloud protocols were literally transcribed and coded. Based on the research question, and prior to coding, the following categories were chosen: 1) lesson characteristics, 2) teachers’ goals during lesson design and teaching, 3) changes in teaching and thinking about teaching, 4) knowledge about, and attitude towards, the new curriculum, 5) references to elements from the professional development program, and, finally, 6) concerns, dilemmas and challenges as experienced during the implementation of the new curriculum. Based on the results of the analysis, subcategories of these main
categories were defined during the coding process (Miles & Huberman, 1994). Using this coding system, we constructed characterisations of each teacher’s thinking concerning their teaching practice in relation to the new curriculum as well as their development. We performed a member check by presenting these characterisations to the teachers during the final interview.

4.4. Results

The results from the three previously mentioned teachers, William, Marion and Nicoline, will be discussed as examples of how different teachers’ goal systems relate to their interpretation of the new curriculum. For each teacher their usual practice, goal system, interpretation of the new curriculum and the changes they made to their regular teaching practice will be described and discussed.

4.4.1 William

Usual teaching practice and goal system
William usually started his lessons by discussing the homework and asking questions to recap the previous lesson. He then would go on to the main body of his lesson, an explanation of new concepts. Subsequently learners started working on assignments and tasks in the course book. William’s main conception of his role as a teacher was that it is his job to explain the structure of the subject material, make connections, and to show learners the bigger picture. This, ‘showing the bigger picture’ was a main goal of his teaching, with which three lower level goals were linked (see figure 4.1). Of course, he had other goals too, such as preparing learners for their exams, and helping them to make connections within textbook texts. Because his school urged him to do so, he has tried out a few active work methods, but he took a negative view of these methods due to his conviction that learners need his explanation to see the bigger picture. A second reason for his dislike was that these activities disrupt classroom routine. Importantly, William saw himself as a storyteller. Telling stories was part of his identity as a teacher. ‘I don’t switch my routine too often… because in my experience it makes it all so inefficient…and basically, I am a storyteller. Students often say to me “you’re good at telling stories but they’re such long ones.” Well, yes, that’s true, but I consider it my responsibility to explain and provide examples, that’s just what I’m good at and that’s my job.’ William stressed this point so strongly that we also consider this to be a main goal, even though it only has two links to higher-level goals.

William’s interpretation of the new curriculum
During the professional development sessions devoted to lesson preparation, William
Figure 4.1 William’s goal system. Core goals have bold outlines.
consistently stressed the importance of explaining the main story, and took this as his starting point for lesson development. During these lessons, his explanations to the whole class remained the core, although he did allow learners more time to work on his newly designed assignments. His choice of contexts was, in the first place, determined by what he assumed pupils to be able to relate to, the same way as in his usual lessons, where he provided many examples to allow pupils to make mental images of the content of the lesson. Secondly, he chose contexts that did not take the focus off the concepts he wanted to teach. He remained unconvinced about other elements of the new curriculum (see table 4.1) because he thought that contexts and context-specific meaning of concepts were over-rated. Also, he feared that allowing learners more time to make their own contributions to the class would detract from a clear understanding of the concepts at hand.

William's take on the new curriculum became even more clear when he discussed existing examples of context-based lessons, his own lessons or those of his fellow participants. He stated that he would choose to use some sections of the existing exemplar context-based lessons to allow learners to practice application, but only at the end of a lesson series. He stressed, however, that the context received too much attention, to the detriment of clear concepts. For example, Concerning Nicoline's lesson series, in which learners took on roles in an ecological advisory company, William said: 'Yes, I tried that out once when we were working on the topic of humans and the environment, but... well, after giving learners three lessons of preparation time, they did the presentations but they just stuck to the text in the book and did not make connections.' When he talked about his own lesson about a tree surgeon, for example, William was clearly uneasy about the way in which a too-dominant context can take the focus off concepts and thus lead to learners who do not clearly understand these concepts. He was wary of letting learners take on roles as participants in a context and said: 'I ask – “what is that tree surgeon doing, and why does he do that?” , instead of asking “well, I am a tree-surgeon and I am going to prune a tree and what should I take into consideration?” .... Yes, but I think that allows me to stay closer to the final answer ...and I think that gives me more control and, I think, faster results.' Later he said about a lesson series made by Norbert 'that is really a challenging context. Which means that I wonder if, for learners, this can be a useful context because you can link so much into it, that I think it will be too difficult for them to see the wood for the trees.'

Williams first "innovative" lesson started with a news headline about car manufacturer Saab that was heading for a bankruptcy. From here followed the (fictitious) question, how many cars could be made from the current stock of wheels, steering wheels and doors. Thus, the Saab parts were an analogy for the concept of “limiting factors” in the process of photosynthesis. The flow of activities in this lesson was still quite traditional: first, William talked his students through the analogy, then the students practiced with exercises in the textbook. In a later lesson, William changed the order of the activities: initially, the students
worked more independently: they read a newspaper article about a prohibition to cart manure and answered questions about the nitrogen cycle. A teacher-centred explanation followed later in the lesson. In a third lesson, William used demonstration practicals and three contexts (a tree surgeon caring for pruning wounds; a florist cutting flower stalks and a lab assistant using test tubes) to help students understand how water transport in plants takes place. We analysed the thinking aloud protocol of William’s design of this last lesson. This showed how William, during his design, deliberated about the order and manner in which he will present the concepts in the lesson: ‘So, I will show root pressure [with a picture or movie showing a blooding plant, later he comes up with the idea of the tree surgeon], next, I will get a flower and show that it sucks the water from a vase, how can it suck water without roots,… that they need to find out that the leaves do that and than a practical in which leaves cannot be used by covering them,… Or a branch without leaves. And compare.’ [etcetera] It is remarkable that William tells his students that pruning wounds are covered in order to prevent water lose, while in reality this is done to prevent infection. “Poetic licence”, William called it, which he felt is needed to present a coherent explanation of the concepts. Williams lesson designs show that he is prepared to let off aspects of his regular teaching practice (the lowest order goals), as long as he makes sure that he can present the biological concepts in a clear and structured manner.

During his final interview William explained that he had not changed his usual way of teaching very much. ‘I was already doing this…I always linked the information to something that the learners can relate to. What I did do was make more conscious use of things like newspaper articles or movies, by using these as focus points for what I tell them.’ To conclude, William said that by teaching his way he met the criteria of the new curriculum (teaching relevant, modern biology) and that he did not need to implement any changes, except to precede his explanation more often by a recent newspaper article or movie.

4.4.2 Marion

Usual teaching practice and goal system

In contrast to other teachers, Marion’s goal system did not clearly follow the build-up of one of her usual lessons, but of a series of lessons. She often designed these in one sitting in which she focussed on a main theme – she called it the umbrella- and a variety of corresponding activities. Marion aimed to use a wide range of assignments and media such as practicals, computer work, films, explanations, etc. She had already given the new curriculum a lot of thought, and this had led to her idea of a main theme, which you could call a “context”. In her opinion, the use of such a theme had obvious merits. For example, it works well to, prior to discussing certain concepts, watch a movie which clarifies these concepts. Another advantage is that lessons are unified by the theme, and thus Marion found it easier to free
herself from the schoolbook. She did, however, find it quite difficult to bring a whole series of lessons together under this one umbrella theme, and so her lesson preparation was very time-consuming. This brought us to another, yet implicit goal: to prepare lessons efficiently.

Marion’s goal system (figure 4.2) shows a number of core goals at different levels, which is notably different from William’s. Her system also clearly demonstrates how a goal system is influenced by the characteristics of a specific group of students. She said ‘normally I would use many more worksheets in this form, but this specific group of learners really likes to react and to hold class discussions, so teaching by classroom conversations well with them.’

The core goals which Marion emphasized most were “to activate and motivate students” and “use a variety of activities and methods”. From her experience as a mentor of new teachers, which includes visiting lots of lessons, she knew how boring school can be for learners. Her hope was that by providing a lot of variety, she would not only motivate and activate learners, but also cater for different learning styles at the same time as presenting the theory in multiple ways. Her other core goals were “to help learners understand concepts and how they are interrelated”; “to teach learners to think logically”; and “to get good exam results”.

Marion’s interpretation of the new curriculum.

For the purpose of this professional development program, Marion made a multitude of new lessons. We will discuss a sub-selection of three lessons here. The first one started with some short practicals: students hold their hands in salt water, shake some salt onto snails and to expose cut flowers to a vase of salt water. She asked learners to explain their observations and she then incorporated what learners have said into her explanation about osmosis. Next, students were asked to use their new knowledge in a new context, which was described on paper: a hospital patient is accidentally given an infusion of distilled water, the patient dies, explain why?

In Marion’s second lesson learners worked with more or less authentic sources: they were given images of blood samples taken at a fertility clinic in order to determine the cause of a couple’s infertility. To answer this, learners needed to delve into anatomy and hormones. Her third lesson featured three short films about the heart; in the first how a transplant heart is transported, the second showed a heart beating outside of the body, and the final film was about a soccer player who has a fatal heart attack on the playing field. During the accompanying classroom conversation Marion explained how the heart is regulated and how an ECG is made.

Marion’s goal system helps us to understand the impact of the professional development program on her teaching practice. There is a strong relationship between her core goals and her interpretation of the new curriculum. She even literally interprets the new curriculum in

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3 Osmosis is diffusion of water through a semi-permeable membrane.
Use a central theme to connect multiple chapters. Choose a theme for which good video material is available.

A movie that explains the theory makes it practical for the teacher.

Diagnosis 1 learn what the students know.

Students know that they know a lot (individually and combined).

Give orders to the chaos in student's heads.

In series of lesson: use variety of lesson types (explain theory/practical work/movies/different kind of student assignments).

During practical work teacher asks many open questions.

In some of lessons use variety of lesson types (explain theory/practical work). Make learning goals explicit for the students.

Figure 4.2 Marion's goal system. Core goals have bold outlines. The goal that has a dotted outline is a goal Marion is less satisfied about.
terms of her own goals. During her final interview she stated that the main issue of the new context-based curriculum ‘[the most important goal] is to get pupils actively involved… To relate the theory to learners’ daily lives. Teaching should use activities which require something from learners…. It’s more the teacher as a coach for active learners.’ Later on, she said ‘in retrospect, this has always been my main focus….so actually what I was doing before, matches the intention of the new curriculum.’ The influence of other core goals is also clearly visible in the lessons she designed, e.g. motivating learners, asking learners to formulate their thinking and the important role of classroom conversation in her teaching. During the final interview it became clear that her goal system had also influenced her implementation of the new curriculum in a different way. Up until then, Marion had been preoccupied with finding a central theme to cover a number of lessons, and this had taken up a lot of her time, whereas her goal system did not show this as one of her main goals. Consequently, it was not hard for her to let go of this idea and to discover that an innovative series of lessons could also be compact, and thus fit easily into her curriculum. ‘This has made me think more positively about the new curriculum, and I am able to implement it more easily.’ After the professional development program, Marion continued making new lessons based on new, current contexts.

4.4.3 Nicoline

Usual teaching practice and goal system

Nicoline chose to study her upper forms, advanced level for this program. She usually started their lessons by asking questions about the previous lesson to refresh their memories. Her usual follow-up was an explanation of new content, illustrated by animations and film fragments. She liked to use short assignments during her explanation to get students thinking and to help them to think through things, because in this way they would retain and understand the content better. She stimulated cooperation between learners during assignments. Towards the end of a lesson she often presented a unifying theme or context, for example a medical case study, to which she returned during a number of lessons to link the concepts which have been studied.

During the interview Nicoline talked a great deal about her goals: she wanted to teach critical thinking, to show how concepts are interlinked, to help learners take sensible steps in their lives without worrying too much, she wanted to stimulate ethical thinking skills and she hoped to engender amazement. Nicoline regarded her own teaching very critically, and asked herself if her actions really tally with her goals. She was one of the few teachers who, during the laddering interview, also explicitly made negative links between goals in the system (see figure 4.3, these negative links are marked by the dotted arrow). For example, she had the impression that explaining to the whole class was negatively linked to her goal of teaching learners to think critically, because lecturing leads to passive learners. But, she
Review previous lesson by asking stimulating questions. Students are able to take care of themselves and their surroundings. Students experience a sense of wonder. Students learn to reason ethically. Students develop a critical and exploring mind. Students see connections and see the bigger picture. Flexible knowledge: students are able to apply their knowledge in different situations. Students retain the material. Link between school and students's own lives. Students are motivated and alert. Give attention to ethical issues. Students experience a sense of wonder. Students understand themselves and their surroundings. Students are able to care for their bodies. Students remember what it was about. Students worry less about things they didn't understand at first. Students develop a critical and exploring mind. Flexible knowledge: students are able to apply their knowledge in different situations. Link between school and students's own lives. Students are motivated and alert. Give attention to ethical issues. Figuur 4.3 Nicoline's goal system. Core goals have bold outlines. The dotted lines represent "negative links". Note: the original goal system was more comprehensive. Because of space limitations, we chose to omit a cluster of goals around the social interactions between teacher and students. Those goals did not appear to have an influence on the decisions Nicoline took during lesson design.
said, ‘I find it very difficult to stop doing this (lecturing).’ She also thought that the way in which she presented the context at the end of a lesson, could make it harder for learners to develop flexible understanding because focussing on aspects of the context can draw their attention away from the concepts.

**How Nicoline interpreted the new curriculum**

Nicoline had many and varied goals she wanted to meet during the professional development. She aimed to trigger learners by touching their emotions and making them more enthusiastic, make them think more deeply, leave off the lecturing, have learners cooperate more, build better a relationship with them, become more creative herself, and design lessons in which learners think ecologically. During the program, Nicoline started off by designing ambitious lessons and she did not shy away from changing her routine. Her lesson about sports doping started with a video clip and a lively text about a Tour de France cyclist who admits to using doping, which she followed-up with a series of questions about the effects of doping and the roles of different components of the blood. In her extended lesson series about ecology, learners first worked on authentic tasks in small groups and shared their findings at a later stage. Her osmosis lesson required learners to explain what happens to different kinds of organisms when exposed to a saltier or more watery environment. Nicoline often said that her own high standards of work hinder her: ‘because of this (my high standards) it always takes up so much of my time; I'm never happy with my work and I force myself to improve this, work on that.’ At the same time, she was positive about her newly designed lessons for this professional development program, she rated her osmosis lesson highly: ‘learners were very enthusiastic and really triggered.’ Her lesson about doping also made her happy: ‘learners were into the context’.

During her final interview, Nicoline turned out to have been stimulated to think about her teaching by the professional development program. Although she was not the only one of the participants to have changed her daily routines, she was one of the few who didn’t say: I was already doing this. In contrast, Nicoline said ‘I’m starting to think the other way around. What I always used to do is, well, we’ve discussed this and that and now it would be nice to show them how to apply these concepts, have they ever thought of this example? But now I try to move this to the start of my lessons …so I look for illustrations – and you can really find horrifying ones – and I ask them, look here, how is this possible? So they start to think …., and yes, this has become sort of automatic with me, I try to fit the concept into something ….in which situations could it be recognizable to learners?’ According to Nicoline, designing context-based lessons has become easier because ‘at first I had the idea that it all had to be something really big…. now I think more like it can be bits and pieces.’ This resulted in Nicoline feeling less of a gap between what she did during lessons and what she wanted to achieve - even with this group of learners who are difficult to motivate.
When, during the final interview, she revisited her goal system, she said it needed revision in order to reflect her current thoughts and actions. Also, an additional goal at the most concrete level needed to be inserted: begin the lesson with an lively introduction and a motivating question, with the aim of activating learners. She did not wish to change her idea about the larger context or theme which she brings up at the end of the lessons because, as she said, ‘I really like connections’. Other parts of her goal system also remained unchanged.

The relationship between Nicoline’s goal system and her interpretation and implementation of the new curriculum was fundamentally different from what we have seen in William’s or Marion’s case. For them, their goal system acted as a lens or filter for those aspects of the new curriculum which supported their existing core goals; whereas Nicoline used the new curriculum to alleviate existing frictions within her goal system.

In the above, we have chosen to limit our discussion of the results to the development of three participants. However, all twelve teachers demonstrated clear relationships between their core goals and their choices about how to implement the new curriculum – although their core goals were all different. We have shown how much difference it makes if someone interprets the new curriculum from the vantage point of teaching as lecturing and explaining the main issues or from the point of teaching as providing activating work methods for learners and/or stimulating learners to think critically and on their own. Some teachers were focussed on supporting learners individual learning styles by adopting a flexible way of teaching (Oliver); others focussed on developing learners’ understanding and their own professional development (Jacqueline) or on stimulating emotional involvement (Ben), etc.

In each case the core goals at the end of the program remained unchanged, while at the same time the majority had integrated aspects of the new curriculum into their practice – that is to say, those elements of the new curriculum that were compatible with their existing core goals.

### 4.5 Conclusion, discussion and implication

The aim of this study was to research how goals systems can be used to make sense of how teachers who took part in the previously described professional development program, interpret the new biology curriculum and integrate it into their teaching. We were especially interested in the role that core goals in a goal system play, and how negative links between goals play out. The goal system of each participant was mapped out during a laddering interview; in each goal system core goals could be identified. Core goals were defined as those goals which have two or more links to goals at higher or lower ranks. These core goals turned out to be very well conserved during the program, at the end of the program each participant had retained their core goals. Also, we found a very strong
relationship between a teachers’ core goals and their interpretation and implementation of the new curriculum because teachers were easily able to implement those aspects of the new curriculum that were congruent with their own core goals. In contrast, non-core goals were easily dismissed or replaced by elements from the new curriculum. Those goals which teachers had described as being ‘more important than other goals’ were, in the majority of cases, the same as the multifinal and equifinal goals we identified (Kruglanski, et al., 2013; Kruglanski, et al., 2011).

Before starting the program, we had surmised that existing goals with negative links to higher goals would have a strong influence on the way the teacher interpreted the new curriculum. Such negative links mean that goals hinder each other, for example in the case of Nicoline when she experiences that lecturing impacts negatively on active thinking by learners. However, Nicoline picked out elements from the new curriculum that allowed her to meet her own higher-level goals (activate learners, stimulate critical thinking skills) especially where she had had negative links before. This points to the idea that negative links can provide targets for the integration of a new curriculum into teaching practice. On the other hand, it is rare for teachers themselves to point out negative links during a laddering interview, even when specifically asked to do so. This raises the question whether negative links do not exist in other teachers’ goal system or if this could be due to the method of elucidating their goal system by a laddering interview. Our feeling is that for other teachers, negative links play a much smaller role. For example, in William’s case you would expect a negative link when he says during the intake interview that he should do less talking, but his lecturing habit does not negatively link to any other goal in his system. This could explain why William, although he had made a resolution to have learners become more active, did not implement this resolution later.

This raises the broader question of the validity of the method and of the resulting goal system. A goal system is a useful construct insofar as it has predictive validity, which is to say that it describes goals which in practice drive lesson design and implementation (Grunert & Grunert, 1995; Yin, 2008). With this in mind, we have paid attention to predictive validity by designing the goal system together with teachers and by using the exact wording that teachers themselves used, i.e. without further categorisation. Secondly, we presented our conclusions about the relationships between goal system and teaching practice to individual teachers and requested their comments. Despite this, a few issues concerning validity still need to be addressed.

The aim of the laddering interview is to chart goals which influence the design and teaching of lessons for a certain group or form of learners. But how to be sure that the goal system contains all the goals which play a role? This research points to some answers. Firstly, each individual teachers’ goal system was robustly linked to their considerations and choices during the design process. Secondly, additional support for the goals as mentioned
in the goal system was found during our other interviews with the participating teachers. However, in three out of twelve cases, goals which were not present in their goal system did, in fact, play a role during the actual design process. This was the case with the following three goals: prepare lessons efficiently, use lesson time and resources efficiently, and, finally, maintain order. These three goals were, for whatever reason, not mentioned during the laddering interview. An explanation for this oversight might be that, because these goals are so deeply ingrained in experienced teachers that they do not even think to mention them when preparing lessons ‘as usual’; but these goals do come to mind when teachers are challenged to design innovative lessons. Such ‘hidden’ goals were only found in a few of the teachers, but even then, they were not core goals and were only linked to one or two non-central other goals within the personal system. To ameliorate this situation in the future, we recommend that the scope of the laddering interview be enlarged in such a way as to bring such hidden goals and links to light. One way of doing so, could be to ask teachers to comment and criticise an innovative sample lesson, and ask them to explain which element they would or they wouldn’t adopt themselves. During our research we did try to discover such hidden goals by asking teachers to give their written feedback on a sample lesson, but because there was no opportunity to probe their answers more deeply or to ask for their reasoning, we could not use this information to complete the goal system more fully.

Another, related, aspect concerns the influence of the researcher on the results of the laddering interview. Following a profound reflection upon laddering interview criteria, Grunert and Grunert (1995) give directions on how to conduct a laddering interview in such a way that is has sufficient predictive validity. We have followed their directions in this study, for example, the interviewer/researcher was a biology teacher and as such well versed in the domain under study; she also used the so-called ‘soft laddering’ technique which means that participants are given as much freedom as possible to speak naturally and to follow their own train of thought, skipping from goal to goal, without interventions aimed at first ‘finishing off’ one goal before moving to the next. Of course, it still remains a subjective decision as to when to terminate follow-up questioning about the why of a specific goal. In this research, the cut-off point was when a participant no longer answered directly or easily. Because in this research none of the core goals were of the highest level of abstraction, this cut-off point was not an essential to our conclusions. At the highest level of abstraction, the goals of very many teachers coincide (prepare learners for their final exams, prepare learners for their future role in society, etc.).

The predictive validity of a teacher’s goal system is context-dependant. We know that there is a strong relationship between the specific goals which teachers aim to achieve, the routines they develop, and both the subject matter content and the forms or levels they teach (Van Driel, Beijaard, & Verloop, 2001). We have addressed this issue by asking the participating teachers to focus on one specific class during the course of the research, and
to design lessons and answer our interview questions with this class in mind. This also means that the validity of their goal system has only been researched for this class. Marion’s case is a clear example of the situatedness of her goal system, as in the group she focused on this study she often uses interactive classroom conversations, which contrasts with her teaching in other forms in which she tends to allow pupils to work independently with work-sheets. On the other hand some teachers, e.g. William, state that it does not make a difference which class they have in mind; and their descriptions of lessons in other forms do indeed match with their statements. According to the participating teachers there were no strong links between the subject content being taught and their goal system, but an excerpt from Nicoline’s interview shows that the topic influences the teacher’s type of goal: *osmosis is like a concept which I think they just need to have encountered so they have it in their minds…. Ecology has a different goal. You teach them a way of thinking. That’s what I think is important.*

Not only the choice of form and topic, but other aspects of the context can impact a teacher’s goal system too (Boekaerts, de Koning, & Vedder, 2006; Shah & Kruglanski, 2008). For example, school culture will influence teaching at a very concrete level, and will also determine whether certain actions will contribute or counteract the attainment of certain goals. Practical constraints, such as surplus or lack of IT facilities can lead to lessons being more or less enlivened by online videos, by online practical activities, by giving learners a chance to judge the quality of online information, etc. In some schools, use of IT is notorious for disrupting the flow of lessons because of network breakdowns, clearly an important practical constraint. However, because we set out to discover the predictive validity of a goal system within the context of a teacher’s job, we consider it to be more of an advantage than a disadvantage that the whole of a school’s specific culture is integrated into the goal system. Further research could bring more to light about the relationship between the goal system and school culture, and, for example, how colleagues can influence an individual teacher’s goal system.

Another aspect that future research could look into might be the effect that a professional development course has on goal systems. In this study we have seen some evidence of such effects, for example in the cases of Nicoline and Marion. But on the whole the situation described here contained too many confounders to be able to unpack these effects, for example some teachers had already integrated elements of the new curriculum into their daily practice, and so also in their goal system, while others, during the year in which the PD program took place, foremost focused on the design of innovative project-like lessons while keeping their ‘regular’ lessons and goal system unchanged. These teachers might have formed a (temporary) goal system that was exclusively linked to these innovative lessons. The implications of such choices are as yet unknown and we cannot draw any conclusions from our research; perhaps the ‘new’ goal system will be integrated with the existing one, or
maybe it will stay separate or even disappear altogether. Other avenues for further research are: does it make a difference that some teachers have a more elaborate goal system than others? Does the level at which teachers discuss their goal system have an impact? Do the goal systems of novice teachers differ from expert teachers, and if so, how?

We can conclude that the results of this research show that a goal system, developed with the help of a laddering interview, helps to make sense of the way that teachers interpret and implement a new curriculum. The two most important relationships we found were the influence of core goals and, to a lesser extent, the influence of negative links between goals. This has implications for research on the relationship between teachers’ goals and their teaching practice; the merit of the goal system is that it gives us a representation of an important part of teachers’ cognitive structure (Kruglanski & Kopetz, 2009). The goal system acts as a lens, which the teacher uses – knowingly or unknowingly – to rate, chose, and adapt elements from a new curriculum. We have shown that in some cases teachers try to align their teaching with the new curriculum, in other cases they cherry-pick those elements from the innovation that fit easily into their existing goal system.

We consider goal systems to form a worthwhile addition to other common methods to chart teachers’ goals and practice (Friedrichsen & Dana, 2005; Kang & Wallace, 2004; Schoenfeld, 2010). Firstly, a goal system shows which goals come into play during a teacher’s daily practice, while other interview methods can produce goals that the teacher considers to be worthwhile but do not really impact his/her daily decisions (Kang & Wallace, 2004). Secondly, a goal system allows for integration of important contextual factors and also relates to larger series of lessons, that is, not just the one lesson. Finally, goal systems are very practical to construct because they can be made during the course of one laddering interview, without the necessity of interpreting and coding large amounts of data. Large scale charting of goal systems can give us invaluable insights into the way that goals play a role in the development of lessons and into how goals impact the actual teaching of lessons. If made at the onset of a professional development course, individual goal systems can allow teacher educators to tailor the course more closely to the needs of the participating teachers (Janssen et al, 2013). Finally, as participants in this study have confirmed, a goal system is a worthwhile instrument for personal reflection on teaching.