Zinnig zoeken: een cognitieve benadering van woordenboekdidactiek Grieks

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Hoofdstuk 6

Opening the black box of expertise

Cognitive Apprenticeship in classics teaching

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Introduction

Classics is undoubtedly the most beautiful school subject (as a classics teacher I acknowledge bias), but can also be the most frustrating one, both to teach and to learn. Especially when students are introduced in reading authentic Greek and Latin texts, they can experience the loss of solid ground to their feet.

This experience is shared by students and teachers. Students notice that, compared to the adapted ancient texts encountered in lower grades, the real classical textual world is not as straightforwardly accessible. Many of the basic rules of thumb seem to have lost their universal applicability (obviously an illusion from the start), because of the diversity of linguistic and literary situations which authentic texts convey. Translating becomes a considerably more complex task.

We, classics teachers, often hear ourselves say frustrating things like: 'this sentence works differently than the rules would predict'. In lower grades, we could comfort our students: 'just learn the conjugations, practice these sentences, follow the steps: then everything will be alright'. When reading authentic texts, we can only try to comfort the students (and ourselves) with the hope that they develop the required *Fingerspitzengefühl* eventually.

As a consequence, classics education can seem a practice of wizardry. When we disclose the solution to a difficult sentence, for students it feels like a magical transformation. For us, as teachers, it is equally mysterious how and when students will master the required tricks themselves. The cognitive processes of both sides seem to be hidden in *black boxes*.

Why is it so difficult to articulate the content of the learning process that leads to successfully analysing and interpreting classical texts? An important reason seems to be that this task requires a complex form of problem solving. There is no 'one size fits all'. It demands a large repertoire of strategies and especially self-monitoring to manage the overall task and reflect on one's progress. Or in other words: metacognition plays a key role.

As teachers, we are experts in classics and are consequently rather remote from this learning process ourselves. Our problem-solving apparatus is now mostly automated and we rarely need to actively self-monitor. A complicating factor is that metacognitive skills, such as self-monitoring, can also be acquired without awareness of its metacognitive nature (Reder, 1996). Teachers may have never been actively aware of executing these skills, not even when they were students themselves. A crucial challenge for teachers, therefore, is to become aware of the cognitive processes which are involved for *beginners* to successfully decode authentic texts. In class, teachers read and translate texts using primarily *implicit knowledge*: intuitive knowledge that is stored in long-term memory.[75] The transfer of implicit knowledge is unpredictable and difficult to control. Moreover, the transferability of this kind of knowledge to other domains is low to begin with (Dienes & Berry, 1997).

For the learning process of students, it is critical that they develop metacognitive skills and are able to communicate about them, but they cannot do this without the help of their teachers. This is because the set of general metacognitive skills novices possess (regulating and planning a task in most general terms) needs to be specialised to be successful in domain-specific circumstances (Veenman, 1999, p. 511). Domain-specific expertise is a condition to be able to meaningfully reflect on one's task performance in a specific domain. Students need an expert who explicitly introduces them into the knowledge and metacognitive activities that are classics-specific. Furthermore, if students become capable of producing explicit metacognitive reflections, their 'black box' becomes more accessible to teachers.

The first step, however, is to make teachers themselves more aware of the complex of strategies, cognitive steps and skills that they master. How can they articulate their expertise in a way that makes it both accessible and transferable to students? This article is dedicated to a teaching method that specifically addresses this question: Cognitive Apprenticeship. It is an approach that builds

[75] There are various accounts of this kind of knowledge (e.g. Reber, 1993; Stadler, 1998; Berry & Dienes, 1993). Implicit knowledge is also strongly related to Kahneman's 'System 1' type of cognition, which pertains to decisions or calculations that are fast, intuitive and not consciously controlled (Kahneman, 2011).

on the principles of traditional apprenticeship to explicate cognitive processes by gradually introducing students to mastering a certain body of expertise.

Our argument consists of two parts. In the first, we discuss Cognitive Apprenticeship as a teaching method and relate it to *situated problem solving*. In the second part, we report on a curriculum design study in which we, together with a group of secondary school teachers, explored how Cognitive Apprenticeship can be implemented in classics education. We limited ourselves to the subject of dictionary use in secondary-school education of Ancient Greek. We first discuss experimental research on dictionary use to explicate the relevant implicit expertise (of expert learners), after which we present the results of the design process in terms of concrete school exercises.

PART 1: THEORETICAL BACKGROUND

1. Cognitive Apprenticeship

The theory of Cognitive Apprenticeship (CA) builds on the observation that schools, in teaching complex tasks, fail to prepare students to real-life problems rather than textbook examples. The reason for this failure is that students are not initiated successfully into the *processes* that experts undertake while solving problems (Collins et al., 1987, p. 4). Teachers tend to execute important problem-solving steps without explicating them to their students – often unknowingly. Similar to our problem analysis regarding classics teaching in the introduction, CA argues that teachers should disclose the *processes* that comprise their expertise.

To teach these processes, CA proposes an educational approach that borrows elements from the traditional apprenticeship method, by which learners are gradually introduced into a certain physical craft (such as pottery or tailoring) by the close guidance of a master-teacher.

The method of CA consists of six elements: *modeling*, *coaching*, *scaffolding*, *articulation*, *reflection*, and *exploration*. The first three are teacher activities. Through modeling, teachers can explicate their own (meta)cognitive steps (or use research data of expert students, see part 2). Coaching consists of

observing students while they perform a task and guiding them by offering direct feedback. Scaffolding means offering support to students by designing tasks that are within their reach (e.g. by focusing on certain parts of the overall task). The next two are student activities and aimed at gaining conscious access to their own problem-solving steps (articulation) and relating them to the steps of their teacher, fellow peers, and their own internal 'model of expertise' (reflection). The final element, exploration, is achieved when all supports are removed and students are stimulated not only to solve problems autonomously, but also define their own problems and research questions.

Collins, Brown, and Newman point out that there are three important differences between cognitive and traditional apprenticeship. First and foremost, in the traditional setting, the skills required to master a certain craft can be readily observed and discussed while they are being executed. The key challenge for cognitive apprenticeship is to make *cognitive* processes visible: the teacher's thinking to the student as well as the student's thinking to the teacher. Second, they argue that skills in the traditional context are often restricted to a certain craft, whereas problem-solving skills in the cognitive domain can be transferable from one subject to the other. To facilitate this, the authors suggest that teachers decontextualize steps, notably metacognitive ones, i.e. they should articulate the abstract principles that they use. Third, the purpose of learning the skills in the traditional workshop is naturally obvious to the learners: the products have a clear role in life. School subjects, however, are often remote from what students encounter in real life. The challenge, according to CA, is to explain how these tasks can be situated in the student's own context.

Stimulating metacognitive skills plays a key role throughout CA, most notably self-monitoring and self-correction. It is important that teachers include metacognitive activities while they model a task on the one hand and stimulate students to reflect on their thinking on the other. A concrete example is the *producer-critic dialogue*, in which students are encouraged to alternately comment on their own performance (producer) and on that of their peers (critic). Other methods include small-group problem solving and so-called

abstracted replay, which means that students retrace a cognitive path by means of a verbal description or a recording.

Similar to traditional apprenticeship, CA emphasizes the importance of learning *within* a certain domain or context, in which students get immersed in the whole set of practices, language and rules that govern it. Factual and conceptual knowledge should be taught and exemplified *in situ* as much as possible, whereas exercises that are isolated from the target context should be kept to a minimum. For classics, this point can be applied to the often difficult transition from the 'textbook perfect' world to translating original texts, the target context of classics education.

2. Situated problem solving

The emphasis on the authentic context in which expert knowledge should be taught, places CA in the field of situated cognition (Robbins & Aydede, 2008). Situated cognition holds that cognition should be seen as an interaction with our (social, cultural, physical, etc.) environment, without making a sharp distinction between 'thinking' and 'doing'. The field is closely connected to 4E-cognition, which views cognition as embodied, embedded, extended and enactive (Newen et al., 2018). In this regard, it is helpful for the purpose of this paper, to include Kirsh's account of situated problem solving (Kirsh, 2008).

Kirsh shares with CA the observation that school assignments often fall short of preparing students for real life instances of problem solving. His point is that the focus in assignments is often on reducing a 'real world' problem to a so-called 'problem space': an abstract representation of the problem, e.g. in a schematic visualization with nodes and links. Problem solving, according to Kirsh, is then subsequently reduced to a heuristic search task *within* this problem space.[76]

His critique on this approach to problem solving is twofold. First of all, Kirsh argues that the actual difficulty in many problems is not so much the

[76] For a comprehensive overview of different types of definitions of problem solving, see Van Merriënboer (2013).

search in a problem space, but *registration*: mapping the real-world situation in which the problem arises with a problem space. A small thought experiment can illustrate his argument. Imagine you are located somewhere in the departures area of an airport and you are headed to a certain location (for example check-in desk 11). On a map alone, it is not very difficult to find the shortest route from any position to desk 11. The challenging part is to register where you actually *are* on the map, and, furthermore, after having decided on the route to take on the map, to 'continually anchor the search space in *locally* meaningful ways' (Kirsh, 2008, p. 276; my italics).

Secondly, Kirsh objects to the non-situational concept of the abstract problem space: it strips away all kinds of situational aspects that are often crucial in a real-world solving process: the use of pen and pencil, a handbook, a ruler, another person, etc. These often concern not-in-the-head features (e.g. extended or embodied) of cognition.

Kirsh's account of problem solving offers a warning and an opportunity with regard to the method of CA. It warns us that teachers should be careful using abstract problem spaces as a method to 'scaffold' a difficult task. In classics teaching it is common to use all kinds of diagrams or translation models in order to help students. As Kirsh points out, however, these abstract versions inevitably fall short of the real world, which, for classics, means: the authentic texts. The challenge for classics teachers is guiding students in their 'registration process': showing them how the often impenetrable world of classical texts relates to specific parts of their (linguistic and cultural) knowledge.

Situated cognition, however, also provides an important opportunity to facilitate this process: we do not have to solve problems using only our heads. In reading or translating a text, for example, we can use a finger to keep focus on a word, a coloured marker to group certain words, a pencil to annotate, etc. It is paramount that teachers, when they model their expertise, disclose not only their thinking, but also these not-in-the-head processes. In this sense, we can borrow even more from the traditional, physical apprenticeship than we may think.

In this regard the concept of *affordances* is relevant, coined by Gibson (1966) and further defined by Norman (1988) as a possibility to act. In crafts, tools can afford all kinds of different actions, which a master can show to a student. In classics teaching, a pencil can afford a student to write, but also to mark a word or group of multiple words into one unit. Furthermore, in the context of dictionary use, a lemma's meta-information offers affordances to students. Signposts, for instance, placed at the start of a (sub)section, can afford to quickly select or exclude parts of the lemma. Introducing students into these affordances is an important part of explicating expertise.

PART 2: THE CASE OF DICTIONARY USE

In the remainder of this paper, we will explore how we can apply the principles of CA in classics education. We will report on the findings of an educational design study regarding dictionary use. The study was conducted in the Netherlands with 12 secondary school Greek teachers. It is part of a larger curriculum design project on dictionary use, the first stage of which describes both problematic and successful student dictionary activities.[77] A summary of these will now follow, which will serve as an introduction into the subject matter.

1. Unraveling (un)successful dictionary behaviour

In secondary school classics education, the transition from textbook practice to studying authentic texts is often accompanied by the introduction of a dictionary – much to the delight of students, who often embrace it as their saviour. Unfortunately, they tend to consult the lexicon excessively, end up at the wrong headword and blindly choose the first translation option listed (Florian, 2017; Bartelds, 2018). As a result, the dictionary is not so much the guide into the language of a classical text (that it potentially is), but a shortcut to a (mostly defective) translation, bypassing the (morpho)syntactic features that structure the text. Dictionary use is a specific example of a skill in classics

[77] Following the principles of *Collaborative Curriculum Design* (Pieters et al., 2019).

education that teachers master implicitly. This competence is difficult to reduce to executing a series of standardized steps and is therefore, just like translating in general, challenging to teach explicitly.

Because teachers, as experts, are often unaware of (all) the (meta)cognitive skills that are involved in successful dictionary use, it is highly insightful to study the behaviour of so-called 'expert learners'. These school students are successful in translating, but are nevertheless still in the process of acquiring expertise, which means that most of their problem-solving behavior is not yet automated and better accessible. We now turn to the key results of two experiments with such students, in the context of Dutch secondary school education of Ancient Greek. In a think-aloud study (Bartelds, 2021), we observed that these learners engaged in a *feedback loop*, frequently moving back and forth between text and dictionary. The participants often consulted the dictionary in an informed manner: they first made (morpho)syntactic or semantic assumptions, which they then actively tested with the information in a lemma, which in turn often prompted them to go back to the text, etc. This can be seen as their way to perform the *registration process* of mapping the text onto the dictionary information. As we have seen, metacognition is important throughout the translation process. These students were monitoring their process, kept a critical eye, and were not afraid to consult a certain lemma again when they suspected a mistake. Moreover, they exhibited situational problem-solving techniques such as placing a finger at relevant positions both in the lemma and in the text – to facilitate moving back and forth – and using the ribbon, fingers or even pens for quick access to certain pages in the dictionary.

The second study made use of eye tracking (Bartelds, 2022). There we learned that the same expert learners were flexible in their navigational strategy. In dealing with complex multilevel lemma's, they did not follow one fixed, systematic approach. They followed a more situational tactic, quickly assessing what information was available to take the path with the lowest cognitive costs. They made active use of the affordances of a lemma's meta-information. Such information afforded excluding certain sections or finding confirmation of the student's hypothesis. Dealing with the meta-information,

even these students struggled with the metalanguage involved in it. This points to an important condition for success: mastering the use of domain-specific terminology. The participants favoured terms that referred to readily discernible features in the text, such as 'with accusative'. More abstract terms such as 'intransitive' were often ignored.

2. Dictionary exercises

These two studies help to explicate successful dictionary behaviour for secondary school classics students. We now turn to the classroom practice itself: concrete exercises in dictionary expertise, based on the principles of CA. The exercises are the outcome of an educational design study in collaboration with a group of teachers in Greek. In a preliminary phase, the participants were instructed in the theoretical framework as presented in the first part of this paper and familiarized with the results of the two empirical studies. We then formulated a number of design criteria for exercises, in order to further translate the method of CA in terms that correspond to the context of classics teaching. It was further stimulated to address the feedback loop and affordances of meta-information, as the key results of the expert-learners experiments. In the subsequent design process, various types of exercises were designed by the teachers in co-creation. They were refined after small trial runs in class. We describe six of these exercises below and clarify for each exercise which methods of CA are included.[78]

Teacher think aloud *(modeling)*

In this exercise, *modeling* is the central method. All the stages of the lookup process are involved. The activity is straightforward: while reading a text, the teacher chooses a word to look up and subsequently verbalizes all the thoughts that come up during the process. It is crucial that the students follow the path

[78] Deze (en andere) oefeningen worden ook uitgebreid besproken in Hoofdstuk 8, in samenhang met de didactische vuistregels en het *Opzoekcurriculum*. Voor de doelgroep van het tijdschrift waar dit hoofdstuk als artikel is aangeboden, hebben we ervoor gekozen de oefeningen te bespreken in termen van de methoden van *Cognitive Apprenticeship*.

of the teacher, not only by listening, but also by physically handling the dictionary themselves. In stimulating students to be enacted in this process, teachers can show how they use their finger scanning for a headword or use the ribbon to mark a page. When we performed this exercise, teachers found it remarkable how many steps it actually takes to go through the lookup process and how complicated it is for students. In this sense, the exercise is also very useful to make teachers more aware of their own dictionary expertise. In class, teachers found out that many students are not aware of the support the design of a dictionary offers (ribbon, headwords on top of pages, etc.).

Guess what not? (coaching, scaffolding, articulation)

Based on the board game *Guess who*, this exercise addresses the process of navigating through multilevel lemmas. It is especially concerned with the affordance of excluding translation possibilities in a lemma. In the original game, two players have a board with images of different cartoon faces. The goal of the game is to guess which face the opponent has chosen, by asking yes-or-no questions. A player can flip an image down when s/he deduces that it can be eliminated.

In the exercise, teachers put coloured sticky notes on the faces of the original board. Each colour represents a lemma of a word in the text which the students are reading. On each of the notes, teachers write down a meaning according to the different levels of the lemma. Students work in pairs or in a group. Their task, while translating the text, is to use a dictionary to find lemma-information on the basis of which they can exclude sublevels. They record their argumentation on a work sheet. Once they decide they can exclude a meaning, they literally flip it down. Students then physically experience the affordance (and joy) of excluding parts of the lemma.

The exercise uses *scaffolding*, because it limits the lookup process to the stage of navigating the subdivisions of a lemma – teachers have already selected the relevant headword. They can further scaffold by including all the relevant lemma-information (such as '*with accusative*') already on the notes. The students can then focus their attention on the playing board and do not have to consult the dictionary itself. The method *coaching* is included, as

teachers can observe when students exclude a meaning – a decision which normally remains invisible. Teachers can also follow the discussions students have and provide feedback. By encouraging students to put their argumentation into words, both in verbal discussions with their peers and on paper, the exercise uses *articulation*.

In a less labour-intensive version of this exercise, teachers can design work sheets with the parts of the lemma in large boxes, in which students cross out what they exclude and make notes on their argumentation.

Dictionary buffet (scaffolding, coaching, articulation)

This exercise is concerned with the feedback loop between text and dictionary and specifically instructs students in the benefits of informed searching. It is suitable for smaller groups of students and relatively labour-intensive. Teachers place a few tables near the wall or window of a classroom. On these tables (the 'dictionary buffet'), they place either sheets of paper with the content of a number of lemmata (an easier version) or just the dictionary itself.

The students are translating in a group sitting away from the dictionary buffet. Whenever they need to look up a word, they walk to the buffet, but are not allowed to bring their text with them. By doing so, students are stimulated to arrive at the dictionary in an informed manner (e.g. by making a hypothesis of the meaning or by assessing the syntactical surrounding of the word). Students physically engage in a feedback loop and experience the costs of looking up a word in isolation of the rest of the sentence: they need to walk back more often than necessary.

Teachers can use scaffolding by annotating the parts of the text which are not included in the selection of words to be looked up. Moreover, it is advisable to select the lemmata of words in the text which are particularly interesting for the process of moving back and forth between text and dictionary.

Students are stimulated to articulate their reasoning, because they work together and have to discuss their decisions while moving to the buffet and interpreting the information. Teachers can coach students by listening to their

thought processes and provide feedback, especially when students are walking back and forth multiple times (or not at all).

Predict the lemma (scaffolding, coaching, articulation, reflection)

Finding the right lemma form is the focus of this exercise. Teachers select a number of words in a text that are relatively difficult to bring back to their lemma form (e.g. Greek verbs). Students are asked to predict the headword of each form (without looking in the dictionary). On a sheet of paper, they fill out a table for each word. They first need to determine the word class, then formulate their reasoning by which they come to their prediction of the lemma.

The task is scaffolded, because students are required to determine the word class of each form. This is a valuable first step in their prediction process. Teachers can further scaffold by asking students to write down the general rules by which each word class is represented as headword.

Again, teachers can engage in coaching because students are stimulated to articulate their reasoning on the work sheet, which makes it accessible for direct feedback. The exercise can be followed by a reflection phase in which the words are looked up and the predicted lemma forms are verified. Students can use check marks and crosses to indicate whether they predicted correctly. Teachers can stimulate students to reflect on their reasoning by discussing the outcome of their predictions with their peers.

The fine print (scaffolding, coaching, articulation, modeling)

This exercise focuses on using meta-information while navigating through a lemma. Teachers select a number of words in a text that have a complex lemma, which is organized by meta-information (e.g. a verb with different kinds of complements). Students need to find the relevant part of the lemma, but need to base their choice on meta-information only. On the work sheet, they write down the relevant translation option and the piece of meta-information that led to their decision. The exercise is concerned with meta-information to show its affordance to select the right lemma part. Students are trained to notice meta-information and learn that it can serve as a helpful

anchor point during the *registration process* of mapping the use of a word in the text to the information in the dictionary.

The task is scaffolded because it limits the lookup process to the navigation stage. Furthermore, teachers can scaffold by selecting lemmata with meta-information that is relatively easy to notice in the text to be translated (such as '*with dative*'). Teachers can use coaching by assessing the work sheets of the students. The exercise can be completed by adding a modeling round in which the teacher invites a few (successful) students to verbalize out loud how they navigate through a certain lemma and assess the meta-information.

Rubric reflect (scaffolding, articulation, reflection)

This exercise is intended to stimulate students to reflect on their dictionary expertise. On a so-called single point rubric, learning goals are formulated that correspond to the different lookup stages (e.g. 'I can arrive at a lemma with a hypothesis of the meaning in my mind'). These goals are placed in the center column and students have the option either to describe how they can move closer to the goal (left side) or define evidence that shows that they master it (right side). Students do this exercise after they have completed a translation task and need to refer specifically to this task when they fill out the rubric. They can then exchange their assessment with a peer and discuss whether the feedback fits (e.g. does the evidence match the goal). Next, they can offer each other suggestions on how to improve their progress in relation to the learning goals.

In a scaffolded version of the exercise, teachers decide the learning goals. By doing so, they divide the lookup process in meaningful steps, which guides the reflection process. In a more demanding version, students are required to formulate the goals themselves. Because students need to add explanations how they can improve on a goal or why they already master it, the method of articulation is included.

Conclusion

At the outset of this paper, we argued that learning classics is a complex task and that, in classics teaching, a considerable portion of the expertise of teachers remains hidden from their students. We have subsequently presented Cognitive Apprenticeship as a promising method to access the black box of expertise. We have attempted to put this method in practice by applying it to the case of dictionary use in the translation process of secondary-school students. We described six exercises that were designed following the methods of CA and the successful dictionary behaviour of expert-learners.

It is important to emphasize the exploratory nature of the study. This study reports the first testing cycle of an educational design study; a next cycle could be a quantitative test on the effect of the exercises on both dictionary skills and dictionary awareness. The exercises were evaluated informally in the teachers' classes by mini trials and were consequently refined. The process was evaluated with the group at the start of each session and with each participant individually at the end of the study. The most important outcome of this evaluation – and this was consistent for every participant – was that the dictionary awareness was boosted among teachers and students. Both teachers and students reported that they had not realized what kinds of steps were involved in a successful dictionary consultation. Students said they often underestimated the complexity of the dictionary on the one hand and the opportunities it has to offer on the other.

In this study, CA was applied to the concrete case of dictionary use as part of translating Greek texts. The expertise involved in consulting the dictionary successfully partly consists of so-called transferable skills: they are also relevant for other kinds of problem-solving tasks. Especially the metacognitive competences of self-monitoring and self-correction, while being engaged in a feedback loop, are very useful for complex tasks in other fields.

Within classics teaching, we think that the exercises can also be applied to dictionary consultation in the Latin context. Moreover, we propose that CA is a fruitful method for teaching comprehension and translation skills in general and also for other competences of classics, such as interpretation,

intertextuality, actualization of themes, etc. The key ingredient for teachers is clear: make the path to expertise visible and accessible.