8. Conclusions and discussion

8.1 Introduction

This study tried to answer the question how teachers should structure instruction when they want to stimulate the development of both basic skills and metacognitive skills. For answering this question, we selected two instructional models, the direct instruction model and the cognitive apprenticeship model. The direct instruction model is a teacher-led, structured model of instruction. The model is strongly related to educational effectiveness research. The cognitive apprenticeship model is based on constructivist ideas about learning and instruction. This model actively involves pupils in the learning process, and explicitly focuses on the learning process by verbalising and discussing this process.

In a quasi-experiment, one group of teachers learned to implement the direct instruction model (N of teachers=5, N of pupils=68), and another group was trained to apply characteristics of the cognitive apprenticeship model (N of teachers=8, N of pupils=114). A control group of teachers (N of teachers=7, N of pupils=92) was not trained. All teachers taught grade 7 of primary schools and they all used the same teaching materials for reading comprehension (Ik Weet Wat Ik Lees). The two experimental groups received a rewritten version of these teaching materials. In addition, the teachers in the experimental groups were trained in five sessions each containing explanation of theory, modelling, practice and feedback. Furthermore, they were coached in their regular classroom setting.

We studied whether teachers were able to implement the models in their regular lessons in reading comprehension. Secondly, we investigated the effects of the two models on achievement, metacognition and attitude. Section 8.2 summarises the results. Section 8.3 discusses the results, followed by a description of the limitations of the study (section 8.4). The chapter is concluded with some suggestions for theory, research and educational practice (section 8.5).

8.2 Summary of the results

The first part of this section deals with the implementation of direct instruction and cognitive apprenticeship. The second part of this section (section 8.2.2) summarises the effects of the two instructional models on learning gains of pupils. Section 8.2.2 also describes whether differences in outcomes are related to specific characteristics of the instructional models.
8.2.1 The implementation of direct instruction and cognitive apprenticeship

The first two research questions asked whether teachers could implement either the direct instruction model or the cognitive apprenticeship model in regular lessons in reading comprehension. The teachers that were trained to apply the direct instruction model showed significant developments on part of the characteristics of the model; namely content of prior lesson, presentation of new skills and independent seatwork. They primarily showed progress in the quality of their instructional behaviour, but they hardly changed the way they spent the lesson time. These developments resulted in significant differences with the control group concerning the content of the prior lesson and presentation of new skills. Furthermore, the quality of the instructional behaviour in general and the time the teachers spent on skills showed significant differences with the control group.

The teachers that were trained to implement the cognitive apprenticeship model showed significant developments on most of the characteristics of the model. Despite these significant developments, the cognitive apprenticeship teachers only differed significantly from the control group on activating prior knowledge and problem solving and co-operative learning. Furthermore, the teachers in this group scored higher on general instructional quality and pay more attention to comprehension skills and metacognitive skills than the control teachers.

As a result of the training, the instructional behaviour of the teachers in the two experimental groups differed significantly. The cognitive apprenticeship teachers showed more attention for activating prior knowledge and problem solving, co-operative learning and applicability. The direct instruction teachers awarded more time and showed a higher quality on the characteristics: content prior lessons, presentation new skills, guided practice and independent seatwork. Thus, we can conclude that the teachers in the two experimental groups implemented significantly different instructional behaviour.

8.2.2 The effects of direct instruction and cognitive apprenticeship

The following four research questions dealt with the short term and long term effects of direct instruction and cognitive apprenticeship on achievement in reading comprehension, metacognition and attitude. We studied the effects of the models separately and we compared the effectiveness of the models. Besides, we studied whether the effectiveness of the models differed for pupils with different intelligence. Table 8.1 presents the effects of the models and illustrates significant positive effects with the effect size.
Table 8.1 Effects of instruction, in effect sizes (P=post-test, F=follow-up)

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<td>standardised test</td>
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<td>0.46</td>
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<tr>
<td>curr.specific</td>
<td>0.53</td>
<td>n.a.</td>
<td>0.38</td>
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<td>vocabulary</td>
<td>0.22</td>
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<td><strong>metacognition</strong></td>
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<td>metacognitive skills</td>
<td>1.19</td>
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<td>0.95</td>
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<td>metacognitive knowledge</td>
<td>0.38</td>
<td>0.32</td>
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<td>focus on learning</td>
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We found that the lessons based on the direct instruction model did not have effect on achievement in reading comprehension, nor on the attitude of the pupils. The direct instruction model did show a significant effect on metacognition, both metacognitive skills and metacognitive knowledge. However, this effect disappeared in the following school year. The lessons based on the cognitive apprenticeship model had a positive effect on achievement in reading comprehension, measured with the curriculum-specific test and the vocabulary test. However, these results did not transfer to a higher achievement on the standardised comprehension test. Besides, these effects did not subsist during the following school year. Furthermore, the cognitive apprenticeship lessons had a positive effect on the metacognitive skills and on metacognitive knowledge. The pupils in this group retained this positive effect during the following school year. Thirdly, the pupils were more focussed on learning (an element of attitude), but this effect was only found directly after the training. Cognitive apprenticeship also showed significant differences with direct instruction, especially during the follow-up. The pupils in the cognitive apprenticeship group scored significantly higher than the pupils in the direct instruction group on the standardised reading comprehension test (follow-up) and the curriculum-specific test (post-test). During the follow-up, the pupils in this group also scored significantly higher on metacognitive skills. Finally, these pupils had a more positive perception of their own skills (post-test and follow-up) and they were more focussed on learning (follow-up), both elements of attitude towards reading comprehension. Cognitive apprenticeship was more effective than direct instruction, because cognitive apprenticeship showed more significant differences with the control group than direct
instruction. Additionally, the cognitive apprenticeship group scored significantly higher that the direct instruction group on several outcome measures.

The effectiveness of the models differed for pupils with different intelligence with respect to achievement in reading comprehension. Cognitive apprenticeship appeared to be more effective for high intelligent pupils, whereas direct instruction had more positive effects on the achievement of low intelligent pupils.

Finally, we studied whether the differences in outcomes could be attributed to specific characteristics of the two instructional models (research question 7). We found that the effect of cognitive apprenticeship on the achievement on curriculum-specific test could be attributed to the general characteristic ‘general quality of instruction’. The effects of the two models on metacognitive skills could be attributed to several separate teacher behaviours. The general characteristics ‘preparatory discussion’ and ‘attention for skills’ showed a positive effect. In addition, two characteristics of cognitive apprenticeship showed significant effects. ‘Modelling’ had a negative effect and ‘discovery learning’, an element of activating prior knowledge and problem solving, a positive effect on metacognitive skills.

8.3 Discussion

This section starts (section 8.3.1) with a discussion of the results concerning the implementation of direct instruction and cognitive apprenticeship. The second part of this section (8.3.2) discusses the effects the models had on achievement, metacognition and attitude.

8.3.1 Discussion of the implementation of direct instruction and cognitive apprenticeship

The implementation of direct instruction primarily concerned changes in the quality of the instructional behaviour. The teachers hardly changed the time they spent on the characteristics of the model. This can be explained by the fact that they already spent a substantial part of the lesson on these characteristics. In other words, maybe the original instructional behaviour of the teachers already corresponded with the behaviour based on the direct instruction model to a large extent. In that case, no large differences were possible. The implementation of direct instruction concerned more the fine-tuning of the instructional behaviour the teachers already showed. This is illustrated by the changes in the quality of the instructional behaviour. These developments indicate that the teachers use the lesson time for activities of higher quality.

The teachers in the cognitive apprenticeship group showed developments in their instructional behaviour on most characteristics of the model. Modelling was the only characteristic that did not show significant developments. A possible explanation is that teachers were not yet used to
verbalise their own reading process. Indeed, some teachers indicated that they experienced modelling as an awkward activity. Modelling is a highly demanding mental activity (Järvelä, 1996), that asks a lot of the teacher. Teachers need clear insights in the reading comprehension process, before they can adequately model this process. The follow-up suggests that the teachers became more confident in using this instructional method, a finding which also occurs in other studies (Hoogendijk & Wolfgram, 1995, Wolfgram, 1999).

In comparison with the teachers in the control group, the cognitive apprenticeship teachers did not spend more time on modelling and discussing the applicability of skills. On the one hand, these two characteristics are new instructional activities that ask teachers to assume a new role. Maybe, the teachers needed more time to implement such activities. The time the teachers spent on modelling during the follow-up suggests such an explanation. On the other hand, modelling and the discussion of applicability might take only little time. In that case, especially the low-inference observational instruments might not have been sensitive enough for registering the occurrence of these activities sufficiently.

The differences between the cognitive apprenticeship and the control group concerned activating prior knowledge and co-operative learning. This latter characteristic primarily concerns a teaching method, in which pupils process the learning materials together instead of by themselves. Initially, this teaching method appears to have fewer consequences for the role of the teacher than other characteristics of the model. Thus, this characteristic might be easy to implement. The measurement of this characteristic can also add to this explanation, since it primarily focussed on time spent on co-operation and less on the quality of the role of the teacher in co-operative learning.

Although the teachers in the two experimental groups did not show significant differences with the teachers in the control group on all characteristics of the models, they did differ from each other on almost all characteristics. Since the three research groups did not differ before the training, the training appears to have changed the instructional behaviour of the two experimental groups in different directions. The instructional behaviour of the teachers in the control group remained in between. In general, the instructional behaviour of teachers appears to contain elements from both the direct instruction model and the cognitive apprenticeship model. The training resulted in instructional behaviour that more strictly agrees with the particular instructional model. However, the teachers in the cognitive apprenticeship group showed more developments in their instructional behaviour than the teachers in the direct instruction group. This suggests that direct instruction lies closer to the regular instructional behaviour of teachers than cognitive apprenticeship.

The larger number of developments in the cognitive apprenticeship group suggests that the teachers in this group were expected to implement an instructional model that differed substantially from their regular instructional behaviour. Such complex innovations can lead to more changes than less ambitious innovations, because complex innovations ask a stronger
dedication and more clear changes from teachers (Fullan, 1991). The opposite counts for the direct instruction group. The teachers in this group only needed to make relatively small changes. Maybe such an innovation results in fewer changes, because teachers do not directly see the differences between their own instructional behaviour and the new behaviour.

8.3.2 Discussion of the effects of direct instruction and cognitive apprenticeship

Both models showed an effect on metacognition. This effect is probably caused by the explicit attention for metacognitive skills within the lessons in reading comprehension in the rewritten teaching materials. The pupils learned to use metacognitive skills before reading, during reading and after finishing reading. This probably also contributed to the development of metacognitive knowledge. The original teaching materials pays less attention to all these skills. This explanation is affirmed by the effect of the percentage of time the teachers spent on metacognitive skills that was found in the multilevel analyses. Additionally, cognitive apprenticeship showed a significant effect on achievement in reading comprehension. This effect was not found in the direct instruction group. This suggests that cognitive apprenticeship is more suitable for the development in comprehension skills. We expect that the combination of the characteristics using prior knowledge and problem-solving, co-operative learning, and applicability contributed positively to this development. When teachers use these characteristics the pupils get insights in the reading process, get opportunities to articulate their reading process, and to embed comprehension skills in their prior knowledge and to transfer the use of these skills to other reading situations. These activities help to internalise the use of skills in the reading process. This might also explain the more positive results of cognitive apprenticeship during the follow-up. When pupils have internalised the knowledge and skills, maybe they can retain these over a longer period of time. This does not count for the pupils in the direct instruction group. These pupils did not retain the effects that were found in the post-test. The metacognitive knowledge and skills pupils in the direct instruction group acquired seem to be less internalised.

The cognitive apprenticeship lessons also showed an effect on the attitude towards reading comprehension. The pupils in this group were more confident about their skills in reading comprehension than the direct instruction pupils. This might have been caused by the active involvement of the pupils in the lessons in reading comprehension. When the teacher stimulates the pupils to use their prior knowledge, to solve reading problems and to discuss the reading process with their fellow pupils, pupils experience that the teacher has faith in their capacities and their motivation to learn. Furthermore, the metacognitive skills provide the pupils with instruments to actively deal with texts and this can also contribute to the confidence of the pupils in their own abilities.
Cognitive apprenticeship was most effective for pupils with high intelligence. These pupils appear to take most advantage from the active participation in the lesson. This might be explained by the interplay between teacher-regulation and pupil-regulation. For pupils with average or high intelligence, less teacher-regulation within cognitive apprenticeship agrees with their regulation skills. Either the teaching activities are in balance with the capabilities of the pupils or the teaching activities challenge the pupils to develop new ways of learning and thinking (constructive friction). The least intelligent pupils showed no progress, in which case there might have been a destructive friction (Vermunt & Verloop, 1999). In line with this reasoning, direct instruction probably showed a destructive friction with the capabilities of the pupils with high intelligence, and a constructive friction with the skills of the low-intelligent pupils. This implies that both cognitive apprenticeship and direct instruction should be adapted to pupils with different characteristics.

The effects of the experimental treatment could hardly be attributed to separate teacher behaviours. It seems that the combination of specific teacher behaviours caused the effects on achievement of pupils. In other words, effective teaching appears to be a conglomerate of behaviours. Than, it is unlikely that one isolated behaviour will make a difference. Rather, the combination of effective teaching behaviours will lead to better performance in pupils (Muijs & Reynolds, 2000).

8.4 Limitations of the study

This section describes the limitations of the study. It goes into whether the teachers that participated in the study are representative for the population of primary school teachers. Furthermore, it describes the limitations of the research instruments, especially the observational instruments on teacher level and the instruments that were used to measure metacognition. Finally, possible hindering factors in the implementation process are discussed.

The three research groups consisted of a small number of teachers. A larger sample would have provided stronger evidence for the success of the implementation of direct instruction and cognitive apprenticeship. Besides, the teachers in the two experimental groups participated voluntarily in the study. This was useful to study and compare the implementation of the two models, because teacher education programs appear to be most effective when they involve teachers that choose to participate (Anders, Hoffman & Duffy, 2000). We know now that teachers who are motivated and committed to implementing a specific instructional model, can change their instructional behaviour towards the model. We do not know whether all teachers can implement direct instruction and cognitive apprenticeship, more specifically when they are less motivated.
For the classroom observation, we used a mixture of low-inference and high-inference methods, with an emphasis on low-inference. However, the percentages of lesson time spent on some behaviours, measured by the low-inference instrument, may be not informative enough as a measure for changes. For example, in the cognitive apprenticeship condition, teachers are supposed to model behaviour, and they are supposed to model more than teachers in the control group. However, modelling does not necessarily take a lot of time. As a consequence, we may not have detected changes even when they did occur. Another example concerns the study of the implementation of direct instruction. The teachers in the direct instruction group already used the lesson time in concordance with the direct instruction model as far as could be detected with the low-inference instrument. When the high-inference instrument would have been more elaborate, we might have found more differences with the control group.

The teachers in both experimental groups were trained to help pupils get insight in the reading comprehension process and the skills that can be used in this process. This requires teachers to shift from attention for the products of reading to attention for the reading comprehension process. Maybe, the extent to which teachers understand this comprehension process themselves has a complementary effect on achievement. We did not have information about the skills and insights of the teachers in this respect.

Metacognition, both knowledge and skills, was measured with a questionnaire. This way, we could gather information from all pupils in the research sample. However, a questionnaire is not the optimal way to measure the use of metacognitive skills. The time between the reading a text and reporting on the use of skills during reading is substantial, and this results in a decreasing validity of the reporting (Ericsson & Simon, 1993). In fact, the questionnaire may not actually measure the metacognitive skills pupils use when they read a text. Instead, it probably measures how pupils perceive their use of metacognitive skills. In the ideal situation, the use of metacognitive skills should be measured during the completion of a task without interfering the task completion. Thinking aloud is a research method that does not interfere with the actual working on a task and it does not disturb thinking processes (Van Someren, Barnard & Sandberg, 1994). Pupils are stimulated to verbalise their thoughts while they are working on a task. However, a drawback of thinking aloud is that analysing thinking aloud data is very time-consuming, especially in large samples. Additional information from thinking-aloud protocols and simulated tutoring (Simons, 2000) would have provided more solid evidence concerning the effects of the treatments on metacognitive skills.

The instructional models were integrated into 16 lessons in reading comprehension. This number is rather small for teachers to implement new instructional models. Maybe the implementation of the new instructional behaviour would have been easier when more lessons were developed or when the instructional models were simultaneously integrated in more school subjects. Besides that, an extension of the training and coaching hours might
have resulted in a more complete implementation of the models. Diagnosing the instructional behaviour of the teacher and adapting the content of the training in accordance with this diagnosis could have further enlarged the influence of the training. That way, the training can focus on instructional behaviour teachers lack or experience as difficult, by providing more extensive explanation and practice about that particular instructional behaviour.

8.5 Implications

This section starts with a discussion of the theoretical implications of the study. Section 8.4.1 goes into how the results contribute to theory about the implementation and effectiveness of direct instruction and cognitive apprenticeship. Furthermore, it discusses the need for theoretical development in which instruction is linked to pupil characteristics and learning goals. The final part about theoretical implications compares the original cognitive apprenticeship model with the model that was used in this study.

Section 8.4.2 starts with some ideas about the design of future research. Furthermore, it discusses the development of more perceptive observational instruments and ideas for collecting additional information on the teacher level that might influence the implementation of new instructional behaviour. Thirdly, this section provides suggestions for an elaborate study of the measurement of metacognition.

The final section (8.4.3) describes some implications of this study for educational practice. These implications focus on teachers, but also on policy-makers and innovators and on educational researchers.

8.5.1 Implications for theory

This study combined elements from two research traditions in one design. As a result, we now have evidence that the direct instruction model can be used to teach metacognition. Furthermore, we know that regular schoolteachers can implement cognitive apprenticeship in a regular classroom setting. Cognitive apprenticeship in a regular classroom setting demonstrated to have a positive effect on reading comprehension and metacognition, even after correction for pupil background characteristics. The study of differential effects showed that cognitive apprenticeship was most effective for high intelligent pupils, whereas direct instruction was the most appropriate instructional model for pupils with lower intelligence. This implies that the effectiveness of the models is related to pupil characteristics. Thus, we need more theory about the relation between instruction and pupil background characteristics. Besides that, we found that direct instruction and cognitive apprenticeship were both effective in term of metacognitive skills. Direct instruction, however, was not effective when reading comprehension was the outcome measure, whereas cognitive apprenticeship did show positive effects on reading
comprehension. Direct instruction seems to be more effective for some outcomes, i.e. basic skills and metacognition, than for others, i.e. reading comprehension. The same probably counts for cognitive apprenticeship. Educational theory should more explicitly deal with the relation between learning goals and instruction. Direct instruction appears to be necessary to some extent (Marlowe & Page, 1998). On the other hand, cognitive apprenticeship also showed effectiveness. Until now, we do not know sufficiently how to design instruction in relation to specific learning goals. The article of Vermunt and Verloop (1999) seems to be a step towards a theory in which learning activities and teaching activities are related. The most effective teachers might be those teachers that are flexible in using different instructional methods, depending on learning goals and pupil characteristics.

To facilitate the implementation of the cognitive apprenticeship model, we elaborated the model into concrete teacher behaviours. Furthermore, characteristics of the model were integrated into a lesson structure. As a result, each lesson represented the characteristics activating prior knowledge and problem solving, modelling, co-operative learning, articulation and reflection and applicability. This cognitive apprenticeship model distinctly shows elements of the original cognitive apprenticeship model as described by Collins, Browns & Newman (1989). However, due to our elaboration the model became more prescriptive than descriptive (Järvelä, 1996). According to Järvelä (1996), the original cognitive apprenticeship model focuses on the process of enculturation, which provides learners with the opportunity to obtain specific skills. In its origin, cognitive apprenticeship is an open learning environment in which elaborated discussions take place. Compared with this definition of cognitive apprenticeship, the model we used in our study shows more structure and explicit instructional methods. On a continuum with direct instruction on one side and the original definition of cognitive apprenticeship on the other side, the cognitive apprenticeship model we used seems to have moved a bit towards the direct instruction model.

8.5.2 Implications for future research

This study showed effects on implementation and outcomes. However, we could not attribute the effects of the treatments to specific characteristics of the models. It would be interesting to replicate the study with a larger research sample. When the research groups consist of more teachers, the results will be more strongly validated. Furthermore, with larger samples we can specify an extra level in the multilevel analyses, namely the level of experimental condition. With this extra level, we can better study the effects of the conditions and of separate teacher behaviours. Besides, multilevel analyses with larger samples would provide more solid evidence about the question whether specific elements of the instructional models cause the effect on the outcomes on pupil level or the combination of these elements.
This study showed clear changes in the instructional behaviour of teachers in lessons in reading comprehension as well as some effects on reading comprehension skills and metacognition of pupils. It would be interesting to study whether similar effects are found when direct instruction and cognitive apprenticeship are implemented in other school subjects. Furthermore, it would also be interesting to study the simultaneous implementation of the models in more school subjects. Then, teachers would get more practice with the instructional model, and the models would be more deeply integrated in education. As a consequence, pupils would be more used to the instructional procedures. There are some studies in which the direct instruction model was implemented in several school subjects (Hoogendijk & Wolfgram, 1995, Wolfgram, 1999). Thus, it would be most interesting to study the simultaneous implementation of cognitive apprenticeship in several school subjects. The lesson activities within this model ask a lot of the pupils; the effectiveness of the model partly depends on the quality of the activities of the pupils. When the model is implemented in more school subjects, not only the teachers get more experience with the activities but also the pupils. This will probably contribute to the quality of the activities. Furthermore, simultaneous implementation of cognitive apprenticeship would make it easier to link or integrate several school subjects and to apply learned knowledge and skills in other subject matters. In sum, it would result in a more profound elaboration of the cognitive apprenticeship characteristic applicability.

In the discussion of the results, we indicated the attention for applications of learned skills in cognitive apprenticeship lessons might have resulted in more internalised knowledge and skills. The discussion of possible applications may stimulate pupils to use the comprehension skills and metacognitive skills they learned in the lessons in reading comprehension in other settings. Future research should study, whether attention for applicability indeed results in using the skills pupils learned in the lessons in reading comprehension in other subject matters.

Cognitive apprenticeship was the most effective model during the follow-up, while the differences between direct instruction and control group faded. To study these long-term effects in more detail, a longitudinal study should be designed in which the treatment covers more grades.

The observational instruments that we used in this study may not have been perceptive enough to detect small, but important developments in the instructional behaviour of the teachers. For future research, the instruments must be refined and extended so they measure more closely the characteristics of the instructional models. To get better insight in the instructional behaviour of the teacher, we also have to develop instruments that provide us with additional information.

Firstly, the implementation of new instructional models depends on the attitudes of the teachers towards the new approach. In cognitive apprenticeship teachers need to give up part of their
control over the lesson. For some teachers this might be very difficult. Some teachers will feel uncomfortable implementing new instructional models, because they are not drawn to the new way of teaching (Lederer, 2000). Measuring the attitude of the teacher can indicate which elements of the model they experience as difficult or inappropriate for their pupils. Probably, this will provide an indication for the lack of implementation of parts of the model.

Secondly, the quality of the instructional behaviour could partly depend on the reading comprehension skills and metacognitive skills of the teacher. Teachers need to have clear insights in the reading comprehension process and the use of skills within this process before they can help pupils to obtain these insights and skills. We assume that the teachers must be experts before they can use modelling and questioning and provide feedback and reflection of high quality. Future research should study the role of attitude and expertise.

In this study, metacognitive skills were measured with a questionnaire. This way, we could gather information about the metacognitive skills of all pupils in the research group. However, a questionnaire is not the only or most appropriate instrument for measuring the use of metacognitive skills. With a questionnaire, the time between the working activity and the reporting is larger resulting in a decreasing validity of the reporting (Ericsson & Simon, 1993). A questionnaire does not measure the real use of skills, but the perception of the use of skills.

Metacognitive skills can also be measured with interviews, thinking aloud protocols, and simulated tutoring (Kluvers & Simons, 1992; Van Hout-Wolters, 2000). However, these three types of instruments also have advantages and disadvantages. In the ideal situation, the use of metacognitive skills should be measured during the completion of a task without interfering the task completion. Thinking aloud is a research method that does not interfere with the actual working on a task and it does not disturb thinking processes (Van Someren, Barnard & Sandberg, 1994). Pupils are stimulated to verbalise their thoughts while they are working on a task. Thinking aloud appeals to the content of the short-term memory. People can easily access the content of the short-term memory, and can reliably report on this content (Ericsson & Simon, 1993). However, thinking aloud does change the task performance. Another drawback of thinking aloud is that analysing thinking aloud data is very time-consuming. Thus, this research method is not suitable to assess the use of skills of large numbers of pupils.

The advantage of using an interview is the opportunity to ask more open-ended questions and to ask questions about answers. Simulated tutoring combines an interview with thinking aloud. Within simulated tutoring, a pupil is asked to explain to a fictive fellow-pupil how to work on a task. The pupil is expected to display knowledge and skills separate from an actual task.

Since all types of instruments have advantages and disadvantages, research is needed that measures metacognitive skills with different instruments and compares the results. This kind
of research shows whether the four types of instruments are suitable for measuring metacognitive skills and how the results from the different instruments relate.

8.5.3 Implications for practice

Governments, organisations and educators agree that education should not just focus on basic skills, but also on more complex outcomes such as metacognition. Youngsters must be prepared to deal with the rapidly changing society; they need to become life-long learners. Schools must provide opportunities for active, self-directed and independent learning to prepare students for this life-long learning. Metacognition plays an important role in this life-long learning.

This study provided evidence that cognitive apprenticeship is the most effective model for stimulating both reading comprehension skills and metacognition. This indicates that teachers who want to change their instructional behaviour within lessons in reading comprehension should implement cognitive apprenticeship focussed on comprehension skills and metacognitive skills. However, the study of differential effects shows that this model is less suitable for pupils with a low intelligence. These pupils learn more by direct instruction. Thus, teachers need to take the abilities of their pupils into account when they choose instructional methods. Teachers should be flexible in using elements from direct instruction or cognitive apprenticeship depending on the needs of the pupils.

This study also showed that it is not easy to change teacher behaviour. The teachers in this study changed their instructional behaviour after receiving training and coaching and with support of teaching materials. Even with this explicit training and guidelines, the teachers did not implement the complete instructional models. In practice, schools and teachers are generally expected to change their education on the basis of general ideas and sometimes on the basis of teaching materials. The results of this study concerning the implementation of the instructional models indicate that this is an unrealistic expectation. Teachers need specific guidelines and training in combination with coaching. Specific guidelines or teaching materials provides them with clear indications of the implications of the innovation. Furthermore, these can serve as scaffolds for the implementation of the innovation. Teacher training and coaching help clarify the rationale behind the innovation, as well as practice under supervision. Thus, policy-makers and innovators should not be satisfied with general prescriptions for an educational innovation. Instead, they should take care of the development of specific descriptions of consequences of the innovation, for example for teacher behaviour. Furthermore, they must supervise the development of teacher training. Educational researchers share this obligation of translating theoretical insights into school practices (De Corte, 2000). They should not just develop theory, but also translate this theory into clear suggestions for teachers and other practitioners. Besides, educational researchers can offer a valuable contribution to the formative evaluation of innovation programs. Since several educational innovations, did not have the expected impact
on improvement of education, it seems to be wise to design small-scale quasi-experiments in which the innovation is tried out. It saves a lot of money, effort and frustrations of practitioners, when large-scale innovations are based on solid empirical evidence.