TEACHING READING STRATEGIES IN SCIENCE AND SOCIAL SCIENCES IN SECONDARY EDUCATION

WILFRIED ADMIRAAL*, PATRICK VAN SCHAIK**, TONNIE BASTIAANSE**, & NELLIANNE VAN SCHAIK-MALJAARS**

*Leiden University ** Calvijn College Goes

Abstract
Many school subjects are taught within the frame of context-based education, which require sufficient reading skills to understand written subject-specific content and real-life information. Yet many students have difficulties to fully understand subject-specific texts and text-related questions. The current study focused on the design, implementation and evaluation of a lesson series in which upper-secondary school students were supported in reading subject-specific texts and assignments. Students showed progress in two of the four reading strategies that were addressed in the lesson series. Moreover, the participating teachers evaluated the lesson series positively, but preferred to integrate some of the working elements in their regular classes. Finally, the teachers reported to become more aware of different ways to support students' reading in their classes.

Keywords: reading strategies, teaching, secondary education

1. INTRODUCTION

In Dutch secondary science and social science education, and in upper-secondary education in particular, context-based education is common practice, as it is assumed to increase students' engagement with subject-specific content of school subjects. In Physics, Life Sciences and Chemistry as well as in Geography, History and Economics subject-specific content is taught in a context that relates to real-life issues in order to stimulate students not only to acquire this content and but also to transfer their knowledge to topics that are relevant for other school subjects and real-life. Tasks, assignments and tests include verbal information that provides real-

Admiraal, W.F., van Schaik, P.W., Bastiaanse, A.A., & van Schaik-Maljaars, N.S. (2018). Teaching reading strategies in science and social sciences in secondary education. Contribution to a special issue in honor of Gert Rijlaarsdam Making Connections: Studies of Language and Literature Education. *L1-Educational Studies in Language and Literature, 18, p. 1-15. https://doi.org/10.17239/L1ESLL-2018.18.03.04*
Corresponding author: Wilfried Admiraal, Leiden University Graduate School of Teaching, Leiden University, Kolffpad 1, 2333 BN Leiden. Tel: 0031-641552127. Email: *w.f.admiraal@iclon.leidenuniv.nl*

life context, which requires good reading to understand tasks correctly. Good reading skills are conditional for student learning in many school subjects (Cromley, 2009; Janssen, Braaksma, & Rijlaarsdam, 2006; Maerten-Riviera, Myers, Lee, & Penfiled, 2010; O'Reijlly & McNamara, 2007). Good readers are able to extract relevant information from assignments, text and other verbal sources and to accurately relate these sources (Gille, Loijens, Noijons, & Zwitser, 2010). More than 70% of the Dutch secondary school teachers state that good reading skills are conditional for students to be successful in the subject they teach (Hacquebord, 2006). Yet secondary teachers also complain that many students have difficulties with reading the information that is provided in school, either in the subject Dutch language or in other school subjects (Hacquebord, 2006). However, teachers do not know at what level students command subject-specific language and what kind of support students need to improve this. The current study focused on teaching reading strategies in science and social sciences in order to improve students' reading of subject-specific information.

2. TEACHER SUPPORT TO IMPROVE READING OF SUBJECT-SPECIFIC INFORMATION

Teacher support to improve subject-specific reading can be framed in so-called language-focused subject-matter teaching, which addresses the acquisition of two types of knowledge simultaneously: about subject matter and about language that is used to verbalize this subject-matter knowledge (Hajer & Meestringa, 2015; Van der Leeuw & Meestringa, 2014). Language-focused subject matter teaching is identified by three key elements: 1) language support, 2) context-rich information and 3) interactivity. Language support can help students to understand challenging context-rich verbal information, which in turn could also help to transfer knowledge to other contexts (Hajer & Meestringa, 2015). A teacher can make language learning goals—subject specific or generic—explicit to students and can provide additional language instruction and feedback during reading. Language-focused subject matter teaching also relates to student learning in meaningful context: teachers teach and assess in a language-rich context by, for example, relating to students' prior knowledge and skills in language and their real-life experiences (Haijer 2005). As in a good teaching, language-focused subject-matter teaching also requires interactivity, between students and teacher, between students and subject matter and between students and their peers. Language-focused subject-matter teaching shares with context-based education the principles of interactivity and teaching in meaningful (i.e. real-life) context, which is most of the time language-rich (cf., Gilbert, Bulte, & Pilot, 2011; Pilot & Bulte, 2006).

In language-focused subject-matter teaching, students' vocabulary also needs attention. In line with distinction between basic interpersonal conversational skills (BICS) and cognitive academic language proficiency (CALP), introduced by Cummins (1979), Gibbons (2009) made a distinction between everyday languages and aca-

demic language. She argues that students should learn to bridge both types of languages to understand subject-specific content. Everyday language refers to language we use daily and is sometimes refer to as common sense language use (Rose & Martin, 2012). Academic language refers to language that is specific for a particular subject or domain and regularly used in the context of teaching and instruction of school subjects in school. Teachers should pay attention to academic language as many students might not command this language at a sufficient level to understand instruction and to complete assignments (Puper, Vissser, & De With, 2013).

Yet explicit attention to students' language is not enough to support students in reading context-rich subject-matter information and to improve their reading skills. Teacher support to improve reading should combine expanding everyday and academic vocabulary with acquiring reading strategies (Fischer, Frey, & Lapp, 2008). The use of reading strategies such as activating prior knowledge, text scanning, preliminary and intensely text reading, and students' reading ability are positively related (Bimmel & Van Schooten, 2004). Three types of reading strategies appear to be most effective. First, students who connect verbalized text to their prior knowledge and experiences from real-life and previous school classes will be more able to understand the information that is verbalized in the text (Fisher et al., 2008; De Corte, Verschaffel, & Van de Ven, 2001; Vernooy, 2011). Students can activate prior knowledge and integrate their prior knowledge with the new information from the text by, for example, predicting text content from the title, heading, tables and illustrations on the basis of their prior knowledge. Although teachers can activate students' prior knowledge as one of their instructional strategies, students should learn to activate their prior knowledge themselves.

A second reading strategy that appears to be effective for student learning includes paying attention to "information-loaded" text elements by, for example, scanning or preliminary reading, searching for key text fragments, making notes and annotations and posing questions. Third, searching for words that indicate text structure, for example "In sum" or "In contrast with", might also help to improve text understanding.

3. THIS STUDY: TEACHING READING STRATEGIES IN SCIENCE AND SOCIAL SCIENCES

Teaching reading strategies seems to be beneficial for students' development of reading skills and their understanding of verbalized subject matter information. A multidisciplinary approach is needed to increase reading skills and understanding of challenging texts in various school subjects (Puper & Richters, 2013). This approach needs to be supported by all teachers in school as Van der Leeuw and Meestringa (2014) claim the more shared a vision in school is, the easier it is to implement reading support for all school subjects. Yet not much insight is available on how teachers can provide reading support and on how both teachers and students evaluate this kind of support. In the current study, we have implemented a lesson series in non-

language subjects in the upper grades of secondary school to support students' reading strategies. The lesson series was designed for upper secondary education (Grade 10-12). It was based on the generic Gradually Released Responsibility Instruction Model (GRRIM) of Förrer and Van de Mortel, 2010). In this model, responsibility for learning is gradually shifted from the teacher to the students. Each lesson of the series includes five stages: 1) activating prior knowledge, 2) orientation and text scanning, 3) reading carefully and actively acquiring vocabulary, 4) completing assignments and 5) evaluating and revising (see Table 1).

Table 1. Design of the lesson series.

Lesson phase	Lesson 1	Lesson 2	Lesson 3
Activating prior knowledge	Teacher plenary questions students about what they already know of the particular theme (e.g. with using a word web).	Student interaction about the content of former lesson.	Small-group work on the content of former lesson.
Orientation and text scanning	Teacher models how to scan a text based on key text elements using think-aloud procedure.	As in lesson 1 but now by a student.	Small-group reading and discussion of predictions about the content.
Reading carefully	Teacher reads the text carefully and addresses everyday and academic language.	Students read individually and check their understanding of vocabulary in pairs.	Students read the text aloud and check vocabulary in pairs.
Completing assignments	Small-group work on completing some assignments using academic language.	Students complete all assignments in pairs using academic language based on a searching reading strategy.	See lesson 2.
Evaluation and revision	Teacher plenary questions students about their vocabulary difficulties during text analysis.	Students evaluate their work in pairs and solve problems with vocabulary.	Small-group work on language-related issues during the assignments and teacher plenary discusses these issues from the small groups.

The procedure of the implementation of the lesson series is summarized in Table 2. Eight teachers participated and first received a 2-hrs workshop on language-focused subject-matter teaching, which was provided by the language coordinator in school. This workshop was supported by a teaching guide to design a lesson series on reading support. In this workshop, the difference between everyday language and academic language was addressed as well. Academic language refers to the language that is used in schoolbooks to teach students a particular school subject; everyday language refers to common sense language use. The two types of language differ in

the level of abstraction and of cognitive complexity (Cummins, 1979) using a different lexis and syntax. Starting from a task in academic language students should be supported to come from everyday language via more cognitive complex language—but still in context—to more abstract academic language (Gibbons, 2009). For example, students work in small groups on an experiment. First, they observe what is going on and think aloud. Then, each group reports on the experiment to another group, with a reference to the particular experiment. Based on these observations and reports, each group formulates general conclusions, which are supported by the teacher with reference to the academic language used in the original task or schoolbook. Students now read these tasks, teachers might explain some words, and students summarize what they have read. After this workshop, the teachers designed their lesson series and each lesson series was discussed with and approved by the language coordinator.

Table 2. Procedure.

Week	Activity
1&2	Workshop teachers
3	Teachers design lesson series
3	Students complete pre-test
4 to 8	Lesson series
8	Students complete post-test
9-12	Interview with teachers

Two research questions are formulated:

1) How do teachers implement and evaluate their lesson series with teaching reading strategies?
2) How do students evaluate the lesson series with teaching reading strategies?

4. METHOD

This study is an explorative study on how the lesson series with teaching reading strategies in science and social sciences was implemented and evaluated.

4.1 Participants

Eight teachers of one secondary school in South-West Netherlands, age between 35 and 63, participated voluntary, each of them with one class (see Table 3). In total, 134 students (81 females, 53 males) participated. This group consisted of 76 general secondary education students, age between 15 and 19 years, and 58 pre-university education students, age between 16 and 19 years. These students attended classes on Geography (n = 31), History (n = 51), Biology (n = 42) or Chemistry (n = 10). All students had the Dutch nationality and Dutch as their native language. Students gave

their consent and had the possibility to opt out at every stage of the research. Yet none of the student did so.

Table 3. Teachers who participated

	School subject	Gender	Age	Teaching experience in years	Grade of students	Educational level
Teacher1	Geography	Male	54	28	Grade 10	GSE
Teacher2	Geography	Male	35	15	Grade 12	PE
Teacher3	History	Male	56	33	Grade 10	GSE
Teacher4	History	Male	39	14	Grade 12	PE
Teacher5	Biology	Male	47	24	Grade 11	GSE
Teacher6	Biology	Male	55	29	Grade 10	PE
Teacher7	Chemistry	Male	46	22	Grade 11	GSE
Teacher8	Chemistry	Male	63	38	Grade 12	PE

Note. GSE= General secondary education; PE= Pre-university education.

4.2 Data

In the same week teachers designed their lesson series, students completed the pre-test on their use of reading strategies (see Table 2). Directly after the lesson series, students completed the post-test. Both pre-test and post-test consisted of an exam text with three assignments followed by the questionnaire items about reading strategies (see below). Finally, a semi-structured interview was conducted with each participating teacher.

To answer the first research question about teacher evaluation, a semi-structured interview was carried out with each of the eight teachers. Each interview consisted of two parts. In the first part, teachers were asked to evaluate each of the five phases of the lesson series. In the second part, more general questions were posed referring to their general impression of the lesson series, their awareness of language-related issues in their classes, whether and how they would like to use the lesson series in the future, and their ideas about improving the lesson series. Each interview was recorded and verbally transcribed. These transcripts were approved by the participants.

To answer the second research question about student evaluation, both the pre-test and post-test examined students' report of reading strategies they used. First, they received an exam text with three assignments. Then they completed 30 items about their use of reading strategies, which were based on the Metacognitive Awareness of Reading Strategies Inventory (MARSI, Mokhtari & Reichard, 2002). All items were answered on a 4-point Likert type scale with *1 = does not apply at all* and *4 = does apply to a great deal*. Based on a validation with 15 Grade 10 students two items were deleted. Principal Component Analyses (oblique rotation) were performed on the pre-test data until no item with cross-loadings of > .30 could be detected. This led to 4 factors with 15 items in total (see Table 4). In addition, six items

about student satisfaction with the lesson series were added to the post test (scored on a 4-point scale as well).

Table 4. Reading strategies questionnaire

Scales	Items	Example item	Cronbachs α pre-test
Activating prior knowledge	6	When I got the text, I first thought of what I already knew of this topic.	0.80
Orientation and text scanning	3	Before I really started to read, I first looked at text elements such as words printed bold or italic.	0.66
Reading carefully	3	If I did not understand a text part, I reread that part.	0.73
Completing assignments	3	I reformulated the text assignments in my own words.	0.73

4.3 Data analysis

To answer the first research question, the interview transcripts were analyzed using the matrix-method as described in Miles, Huberman and Saldata (2014). First, each teacher interview has been summarized in a case matrix following the setup of the lesson series (Table 1). A data row was added consisting of additional annotations of the researchers. Second, for each lesson phase and for the entire lesson series, the interview statements were clustered into teachers' implementation, their general evaluation including perceived benefits for students, the perceived applicability of the lesson series, their future use and the main benefits for the teachers. Third, the teacher matrices were combined into a cross-case matrix. In this cross-case matrix, all authors collaboratively added their annotations that refer to relationships between the lesson phases and lessons, contrasting views of the researchers, distinctive negative or positive evaluations of the teachers, and similarities between the teachers. All lessons were taped on video for a fidelity check of the lesson series. In general, the lesson series were implemented as designed following the phases summarized in Table 1. In 8 out of 24 lessons, teachers did perform the evaluation and revision (phase 5) a bit different because of time concerns.

To answer research question 2, descriptive statistics were calculated for the six student evaluation items of the post-test questionnaire. To examine a change in students' reading strategies, repeated measures analyses of variance were performed on each of the four reading strategies as dependent variable, time (pre-test vs post-test) as within-subject variable and educational level (general secondary education and pre-university education) as between-subjects variable. These analyses were repeated for school subject instead of educational level as between-subject variable.

5. RESULTS

5.1 Teachers' evaluation of the lesson series

Teachers reported their opinions about 1) the implementation of reading support in their lesson, 2) their general evaluation including their perceptions of what their students learn from it, 3) the applicability of the lesson series, 4) future usage of the lessons series in the future, and 5) their perceived outcomes.

5.1.1 Implementation of the lesson series

In phase 1, all teachers were focused on activating prior knowledge of their students. This was less the case in lesson 3, because in some cases lesson 2 and 3 were scheduled directly following each other. In phase 2, all teachers practiced orientation and text scanning with their students, both plenary as teacher model and by students individually. In phase 3, all teachers paid attention to differences between everyday language and academic language, but teachers generally did not initiate different student learning activities to bridge the gap between everyday and academic language. In the phase of completing assignments (phase 4), most teachers followed the design principles of having individual students, pairs or small groups working on the assignments and exchanging their experiences. One teacher skipped this phase in lesson 2, because it was scheduled directly before lesson 3 and he did need more time to finish the phases in the next lesson. Finally, phase 5 was the least successfully implemented. In 8 out of the24 lessons, this phase was not carried out fully because of time issues. In most cases, this referred to lesson 2 that was scheduled directly before lesson 3 with only one time phase 5 at the end of lesson 2.

5.1.2 General evaluation of the lesson series

Both phase 1 and 2 (activating prior knowledge and orientation and text scanning, respectively) teachers evaluated positively, although two teachers experienced some problems with modelling orientation and text scanning. Teachers reported that their students generally were engaged with activating prior knowledge and applied what they had modelled. Some students had problems to start up their orientation activities and text scanning as they did not know where to start, what should be read and what should be skipped for that moment. Additional direct instruction by the teachers helped them. In general, teachers reported that it was useful to think aloud and verbalize predictions about the text explicitly. The other phases teachers evaluated as moderately positive. For phase 3, teacher reported that their students evaluated the explicit attention to the difference between everyday language and academic language not always as useful as students reported that they were already aware of this difference. Yet from their observations, teachers reported that students were better prepared and approached the text and assignments differently

than before. For phase 5, teachers should schedule more time to do it in thorough way. All in all, teachers evaluated the lesson series positively and they think it will have an effect on student outcomes, if applied by teachers of all school subjects.

5.1.3 Applicability of the lesson series

In the interview, teachers mentioned that the lesson series design was a good starting point but that it costed too much time to implement it fully. All teachers reported activating prior knowledge (phase 1) to be useful and easy to implement. They also thought it had some additional value to their regular teaching practices. This is also the case for modeling of orientation and text scanning (phase 2), especially when this is done by well-performing students. Modelling by the teachers is already part of regular teaching practices. Teachers' thoughts about the applicability of the other three phases were less positive. The way the difference between everyday language and academic language was addressed in the lesson series was evaluated as too restricted, although teachers value the topic as such. They would like to integrate the explicit attention for the difference between everyday language and academic language in their regular teaching. For phase 4 (completing assignments) they also felt that the prescribed formats to teach the completion of assignments were too restricting as teachers had the idea that they themselves can decide how to teach and use different formats for teaching. Finally, teachers assessed phase 5, evaluating and revision, as the most difficult one. In their regular teaching, teachers are used to evaluate and provide feedback on the content of the particular school subject, not on language issues. They indicated that they would like to be more supported in this task.

5.1.4 Teachers' future support of reading strategies

Teachers reported that they will use parts of the lesson series and integrate these in their regular teaching. These parts are activating prior knowledge (phase 1), orientation and text scanning (phase 2) and reading carefully with attention for the difference between everyday language and academic language (phase 3). Activating prior knowledge with use of a word web is already part of regular teaching practice of some teachers; they would like to use it more often. Orientation and text scanning is also an activity teachers would like to use more often as in this way they think students better understand the relationships between sources. More attention for the difference between students' everyday language and academic language could be more often addressed in practicing with final exam texts and assignments. Although in some lessons teachers did not do the evaluation phase, all teachers mentioned that it is important to evaluate language performance and provide feedback on students' language use. In general, they valued most elements of the lesson series, but they would like to integrate these elements in a way that fits them better. This is also related to time and effort. The lesson series as evaluated in this study,

took them too much time and was presented in a too strict format. The teachers also mentioned that teachers of other school subjects should use a similar support of reading strategies and that it should be repeated quite some times.

5.1.5 Teachers' perceived outcomes: awareness of the need for reading support

Although all teachers mentioned that the format of the lesson series was too restricted, they reported that they became more aware of the need to support their students in their reading strategies. The format did help to think about it in a systematic way, but should not be followed thoughtlessly. Especially activating prior knowledge (phase 1) and orientation and text scanning (phase 2) were evaluated positively and could be integrated in regular teaching easily. This is also true for attention for the difference between everyday language and academic language, which made teachers more aware of this difference and that they should address this in their teaching more explicitly.

5.2 Student evaluation of the lesson series

In general, students evaluated aspects of the lesson series rather positive. The means scores are around 2.5 (out of 4.0). Activating prior knowledge was the least positive evaluated activity (mean score 2.16) and orientation and scanning text the most useful (mean score 2.71). In Table 5, the evaluation results are summarized.

Table 5. Student evaluations

How useful you think is…	*M*	*SD*
.. activating prior knowledge	2.16	0.94
.. orientation and text scanning	2.71	0.88
.. teacher modeling	2.33	0.97
.. attention for academic language	2.43	1.03
.. attention for difference everyday language and academic language	2.44	0.93
.. evaluation and revision	2.59	0.93

In Table 6, we have summarized the results of the pre- and post-test. After the lesson series, students reported a stronger emphasis on activities to activate their prior knowledge ($F(1,132) = 4.52$; $p = 0.035$; $\eta^2_{partial} = 0.03$), and on orientation and scanning text ($F(1,132) = 24.09$; $p < .001$; $\eta^2_{partial} = 0.15$), compared their reports prior to the lesson series. This indicate a small and moderate effect size, respectively (cf. Cohen, 1988). No main effects of the lesson series were found with respect to the other two reading strategies. No interaction effects of lesson series by either educational level or subject matter were found which means no differences can be found in effects of the lesson series between general secondary education and pre-university education, and between Geography, History. Biology and Chemistry.

Table 6. Results of the reading strategies

	GS (*N* = 76)	PE (*N* = 58)	Total (*N* = 134)
	M (*SD*)	*M* (*SD*)	*M* (*SD*)
Activating prior knowledge			
Pre-test	2.63 (0.61)	2.50 (0.62)	2.57 (0.62)
Post-test	2.66 (0.62)	2.73 (0.68)	2.69 (0.64)
Orientation and text scanning			
Pre-test	2.08 (0.71)	1.83 (0.56)	1.98 (0.66)
Post-test	2.28 (0.68)	2.25 (0.68)	2.27 (0.68)
Reading carefully			
Pre-test	3.29 (0.64)	3.30 (0.65)	3.29 (0.65)
Post-test	3.31 (0.56)	3.30 (0.53)	3.31 (0.55)
Completing assignments			
Pre-test	2.48 (0.77)	2.31 (0.72)	2.41 (0.75)
Post-test	2.43 (0.76)	2.38 (0.78)	2.41 (0.76)

Note. *M* = mean; *SD* = standard deviation; GS = General secondary education and PE = Pre-university education.

6. DISCUSSION AND CONCLUSION

Teachers evaluated the reading support they provided for their students in terms of the lesson series positively. This is the case for all phases, although some teachers did not have enough time to fully implement the phase of evaluation and revision. Yet all teachers indicated that they will make more time for this in their future teaching. Teachers evaluated the lesson series as too time consuming and the format as too restricted. Therefore, they would like to implement the elements of the lesson series as part of their regular teaching. The main outcomes of this study at the teacher site are their awareness of language and reading issues in their teaching and how teachers can support students' reading strategies in order to better understand texts and assignments in their school subject. This awareness seems to be a first, but crucial step to enhance teaching quality and consequently student learning.

With respect to the various phases of the reading support in each lesson, the positive evaluation of activating prior knowledge aligns with findings of Fisher et al. (2008), De Corte et al. (2001) and Vernooy (2011). These authors conclude that it is beneficial for students' learning outcomes when students relate the content of the reading text to previous knowledge and experiences. Apparently, the teachers also were quite successful in activating prior knowledge and experience as this was one of the reading strategies students reported more after the lesson series than before. Yet students did value the strategy of activate prior knowledge and experiences the least. Students evaluated most positively the strategy of orientation and text scanning, which was the other reading strategy students reported more after the lesson series than before. So, it seems that the reading strategies that were valued most—either by the teacher or by the students—improved during the lesson series.

In general, students evaluate the elements of the lesson series as moderately positive. In class, teachers did not make explicit the importance of reading support, which might be one of the reasons of the moderately positive evaluations. Again, when teachers are more aware of students' issues with reading and reading strategies, they could also be more explicit to their students about the goals of supporting reading strategies.

The positive evaluation of support of reading strategies underlines the importance of reading support as already argued in other studies (e.g., Förer & Van de Mortel, 2010), in which both activating prior knowledge and text orientation appear to be two successful strategies to better understand the information (Bimmel & Van Schooten, 2004). In our evaluation, little attention was paid to the difference between everyday language and academic language. At the start of the project, teachers indicated two main problems: students' lack of effective reading strategies and their misunderstanding of academic language that is used in educational materials in school. But during the lesson series students' knowledge of academic language was not perceived as a major issue, neither by the teachers nor by the students.

6.1 Limitations

Three limitations should be addressed here. First, the research design of the current study does not allow definite answers whether the lesson series had an effect on students' reading strategies. For this, a comparative research design should be setup in which the outcomes of the intervention are compared to a comparison group without the intervention (control group design or cohort design). We did not decide for this kind of research design as the lesson series was designed and implemented for the first time and many revisions were expected. Therefore, a more exploratory research design provided us with more meaningful information.

Second, for measuring students' readings strategies we have used a questionnaire. Consequently, we did not measure students' actual use of particular reading strategies, but their self-reported strategies during a task just prior to completion of the questionnaire. An alternative would be to make use of a thinking-aloud protocol in which students verbally report during completion of a task what they are doing and why (Haak, Jong, & Schellens, 2006).

Third, from the interview data it became clear that teachers differed in the very concrete way they implemented the lesson series. One of the reasons for this difference might be the workshop that prepared the teachers for the lesson series. This workshop lasted only two hours, spread over two weeks. In their review study, Van Veen, Zwart, Meirink and Verloop (2010) argued that to be effective teachers' professional development requires substantial time, effort and support. A more similar way of conducting the lesson series by the teachers might be achieved by a more intensive teacher preparation or by prescribing teaching activities in each phase. Yet the teachers of the current study already experienced the approach to be too restrictive and prescribed.

6.2 Implications for preparing teachers

In the current study, teachers were prepared for designing and implementing a lesson series by a 2hrs-workshop. We already mentioned that this workshop should be longer and it might also include some coaching during the design phase of the lesson series. Additionally, schools could use a guide for language-focused subject-matter teaching, developed by Hajer and Van der Leeuw (2013). In this guide, indicators of professional development are described for large groups of teachers in language-focused subject-matter teaching. The workshop used in the current study should be further improved in at least three aspects. First, some teachers did not understand the phase of activating prior knowledge correctly. It should be clear that the aim of this phase is not activating prior knowledge as such, but integrating new knowledge into already existing knowledge and experiences. Secondly, more attention should be paid to how to distinguish explicitly between everyday language and academic language that is used in educational materials for school subjects. Gibbons (2003) present a case study of two teachers who "mediate" between students' everyday language and commonsense understanding of science, on the one hand, and the educational discourse and specialist understanding of the subject, on the other. More practical insights into this teachers' mediation are needed, especially in L1 content-based classrooms. Thirdly, teachers tended to just pick some elements and activities from the lesson series design to put into practice. It should be clear that the more integrated activities and teacher support with respect to students' readings strategies are, the more beneficial they are for improving students' understanding of texts and assignments (Bimmel, 2001, Fischer et al., 2008).

6.3 Future research

Future research could be set up on how teachers can integrate the key elements of the lesson series in their regular teaching. One important problem to be studied then is whether crucial elements of teacher support for reading strategies are better integrated in regular teaching practices in the long run or that over time attention for language-focused subject-matter teaching will fade. Another line of research might focus on the collective aspect of providing teacher support for students. From literature on teachers' professional development (cf., Van Veen et al, 2010) we know that in order to be effective at school level professional development activities should be collective and put into practice from the perspective of school policies. This might not be different for language-focused subject-matter teaching. In this respect, it would also be interesting to examine school leadership and their role in school policies in the domain of reading support. Finally, a third research direction is to measure students' reading strategies in another way than self-reports, for example by think-aloud protocols, observations or tests.

6.4 Concluding remarks

Teacher support led to an increase of students' activating prior knowledge and of orientation and text scanning, which undoubtedly lead to better understanding and performance. Moreover, by the lesson series teachers became more aware of language issues and reading strategies students use to learn from subject-specific texts and assignments. They appreciated all phases of the lesson series, but would like to have more autonomy to decide which parts of the lesson studies they integrate in their teaching and ideas how they can support reading strategies of their students.

ACKNOWLEDGEMENTS

This research has been partly financed by the Zeeuwse Academische Opleidingsschool (ZAOS), project Versterking Samenwerking Lerarenopleidingen en Scholen (VSLS).

REFERENCES

Bimmel, P. (2001). Effects of reading strategy instruction in secondary education - A review of intervention studies. *L1-Educational Studies in Language and literature*, *1*(3), 273-298. https://doi.org/10.1023/A:1013860727487

Bimmel, P., & Schooten, E. van. (2004). The relationship between strategic reading activities and reading comprehension. *L1-Educational studies in Language and Literature*, *4*(1), 85-102. https://doi.org/10.1023/B:ESLL.0000033844.88918.e7

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences (2nd. ed.).* Hillsdale, NJ: Lawrence Erlbaum Associates.

Cromley, J. G. (2009). Reading achievement and science proficiency: International comparisons from the programme on international student assessment. *Reading Psychology, 30*(2), 89–118. https://doi.org/10.1080/02702710802274903

Cummins, J. (1979). Cognitive/academic language proficiency, linguistic interdependence the optimum age questions and some other matters. *Working Papers on Bilingualism, 19*, 1-9.

De Corte, E., Verschaffel, L., & Ven, A. van de. (2001). Improving text comprehension strategies in upper primary school children: A design experiment. *British Journal of Educational Psychology, 71*(4), 531-559. https://doi.org/10.1348/000709901158668

Fischer, D., Frey, N., & Lapp, D. (2008). Shared readings: Modeling comprehension, vocabulary, text structures, and text features for older readers. *The Reading Teacher, 61*(7), 548-556. https://doi.org/10.1598/RT.61.7.4

Förrer, M., & Mortel, K. van de. (2010). *Lezen … denken … begrijpen* [Reading … thinking … understanding]. Amersfoort, the Netherlands: CPS Onderwijsontwikkeling en advies.

Gibbons, P. (2003). Mediating language learning: Teacher interactions with ESL students in a content-based classroom. *TESOL Quarterly, 37*(2), 247-273. https://doi.org/10.2307/3588504

Gibbons, P. (2009). *English learners, academic literacy, and thinking*. In T. Meestringa (Ed.), *Werken aan vaktaal bij exacte vakken* [Working on subject-specific language in Science]. Enschede, the Netherlands: Platform Taalgericht Vakonderwijs/SLO.

Gilbert, J. K., Bulte, A. M. W., & Pilot, A. (2011) Concept development and transfer in context-based science education. *International Journal of Science Education, 33*(6), 817-837. https://doi.org/10.1080/09500693.2010.493185

Gille, E., Loijens, C. Noijons, J., & Zwitser, R. (2010). *Resultaten PISA-2009: Praktische kennis en vaardigheden van 15-jarigen. Nederlandse uitkomsten van het Programme for International Student*

Assessment (PISA) op het gebied van leesvaardigheid, wiskunde en natuurwetenschappen in het jaar 2009 [PISA results 2009]. Arnhem, the Netherlands: CITO.

Haak, M., Jong, M., & Schellens, P. J. (2006). Hardopdenkprotocollen en gebruikersonderzoek; volledigheid en reactiviteit van de synchrone hardopdenkmethode. [Think-aloud protocols and user research].*Tijdschrift voor Taalbeheersing*, *28*(3), 185-198.

Hacquebord, H. (2006). Woordkennis als onderdeel van taaldiagnostisch onderzoek [Vocabulary as part of language-diagnostic research]. *Levende talen tijdschrift*, *7*(1), 15-22.

Hajer, M. (2005). Taalgericht vakonderwijs: tijd voor een nieuw vijfjarenplan [Language-focused subject-matter teaching]. *Levende Talen tijdschrift*, *6*(1), 3-11.

Hajer, M., & Leeuw, B. van der. (2013). *Werken aan vaktaal/taalgerichte vaklessen ontwerpen* [Working on academic language/designing language-focused subject-matter teaching]. Concept 1. Enschede, the Netherlands: SLO.

Hajer, M., & Meestringa, T. (2015). *Handboek taalgericht vakonderwijs* [Handbook on language-focused subject-matter teaching]. Bussum, the Netherlands: Coutinho.

Huber, J. A. (2004). A closer look at SQ3R. *Reading Improvement. 41*(2), 108-112.

Janssen, T., Braaksma, M., & Rijlaarsdam, G. (2006). Literary reading activities of good and weak students: A think aloud study. *European Journal of Psychology of Education, 21*(1), 35-52. https://doi.org/10.1007/BF03173568

Leeuw, B. van der, & Meestringa, T. (2014). *Genres in schoolvakken. Taalgerichte didactiek in het voortgezet onderwijs* [Genres in school subjects]. Bussum, the Netherlands: Coutinho.

Maerten-Rivera, J., Myers, N., Lee, O., & Penfield, R. (2010). Student and school predictors of high stakes assessment in science. *Science Education, 94*(6), 937–962. https://doi.org/10.1002/sce.20408

Mokhtari, K., & Reichard, C. A. (2002). Assessing students' metacognitive awareness of reading strategies. *Journal of Educational Psychology, 94*(2), 249–259. https://doi.org/10.1037/0022-0663.94.2.249

Miles, M. B., Huberman, A. M., & Saldata, J. M. (2014). *Qualitative data analysis. A methods sourcebook. Third revised edition.* London, UK: Sage Publications.

O'Reilly, T., & McNamara, D. S. (2007). The impact of science knowledge, reading skill, and reading strategy knowledge on more traditional "high-stakes" measures of high school students' science achievement. *American Educational Research Journal, 44*(1), 161–196. https://doi.org/10.3102/0002831206298171

Pilot, A., & Bulte, A. M. (2007). Editorial: Why do you 'need-to-know': context-based education. *International Journal of Science Education*, *28*(9), 953-955. https://doi.org/10.1080/09500690600702462

Puper, H., Richters, J. (2013). *Beter lezen, beter leren. Vakteksten begrijpen in het voortgezet onderwijs en middelbaar beroepsonderwijs* [Better reading, better learning]. Amersfoort, the Netherlands: CPS.

Puper, H., Visser, M., & With, T. de. (2013). *Woordenschatonderwijs: meer dan woorden leren* [Vocabulary: more than learning words]. Amersfoort, the Netherlands: CPS

Rose, D., & Martin, J. R. (2012). *Learning to write, reading to learn: genre, knowledge and pedagogy in the Sydney School*. Londen, UK: Equinox.

Veen, K. van, Zwart, R., Meirink, J., & Verloop, N. (2010). *Professionele ontwikkeling van leraren. Een reviewstudie naar effectieve kenmerken van professionaliseringsinterventies van leraren* [Teachers' professional development]. Leiden, the Netherlands: Expertisecentrum Leren van Docenten, Universiteit Leiden.

Vernooy, K. (2011). *Ontwikkelingen op het gebied van (begrijpend) lezen. Wat werkt?* [Developments in the area of reading comprehension]. Paper presentation at the Hogeschool Edith Stein Hengelo.