



OPEN ACCESS

EDITED BY

Katherine Susan Binder,
Mount Holyoke College, United States

REVIEWED BY

Rocsana Bucea-Manea-Tonis,
National University of Physical Education and
Sport, Romania
Suthathip Thirakunkovit,
Mahidol University, Thailand

*CORRESPONDENCE

Mariska Okkinga
✉ mariska.okkinga@gmail.com

RECEIVED 19 May 2025

ACCEPTED 26 August 2025

PUBLISHED 16 September 2025

CITATION

Okkinga M and van Gelderen A (2025)
Task-oriented reading in higher education:
effects of two types of scripted collaboration.
Front. Educ. 10:1631174.
doi: 10.3389/feduc.2025.1631174

COPYRIGHT

© 2025 Okkinga and van Gelderen. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

Task-oriented reading in higher education: effects of two types of scripted collaboration

Mariska Okkinga* and Amos van Gelderen

Research Centre Urban Talent, Rotterdam University of Applied Sciences, Rotterdam, Netherlands

Introduction: Task-oriented reading is an important skill in higher education. However, many students in higher education have little experience in this type of reading and lack strategies for executing it efficiently and effectively. The aim of the present study is to design and test a learning environment in realistic classroom settings to foster task-oriented reading in higher education.

Methods: A learning environment was designed and tested experimentally in a series of lessons to aid teacher students of different disciplines ($N = 105$) in the process of task-oriented reading in two stages: homework and group discussion. Using a pre-post experimental design, two types of scripted collaboration were compared: one group received role assignment only, while the other group additionally received instructions about different phases in the collaboration process. Two task-oriented reading tasks (pre- and post-test) were designed, each consisting of four texts and 11 open-ended questions about these texts. Students' activities during task execution were logged.

Results: Both groups significantly improved performance between pre- and posttest. However, results showed no significant differences between the two groups in growth between pre- and posttest. Logs of task execution showed that all students spent more time on reading relevant text parts at posttest and spent less time on question reading and answering at posttest, suggesting that students executed task-oriented reading more efficiently as a result of the learning environment.

Discussion: The results suggest that students exhibited greater efficiency in navigating between their task and text representation, which is in accordance with literature on the process of task-oriented reading. No significant differences were found between the two types of scripting, indicating that the phased discussion did not confer any advantage over role assignment only. This difference may be attributed to the relatively small difference between the two types of scripting.

KEYWORDS

task-oriented reading, reading-to-learn, learning environment, technology-enhanced, reciprocal teaching

1 Introduction

Reading is a fundamental skill that plays a crucial role in academic success, from primary education through to higher education. However, results of international comparisons show that there is a substantial group of students that do not meet minimal standards for reading comprehension in adolescence (OECD, 2023). As students enter higher education, the problems they encounter with reading may become aggravated in this new educational context. A recent

review showed results based on a small number of studies on reading comprehension in higher education (De-La-Peña and Luque-Rojas, 2021). According to these studies, students have difficulty making inferences, identifying the structure of written text, and using effective reading strategies (Bharuthram, 2017; Livingston et al., 2015; Ntereke and Ramoroka, 2017). In higher education reading comprehension is directed at reading for learning in different subject areas and disciplines (MacLellan, 1997). In addition, and in contrast to the context of secondary education, students are expected to engage with rather complex and long texts in order to learn. In all disciplines students are required to use texts to complete tasks aiming at the acquisition of new domain specific knowledge and insight into conceptual relations.

Another issue is that students in higher education are formally expected to read a substantial number of pages before coming to class so that time in class can be devoted to discussion and critical thinking (Berry et al., 2010). However, the majority of students does not complete the assigned reading work (Clump et al., 2004) has little experience in this type of independent reading, and lacks strategies for executing it efficiently and effectively (Doolittle et al., 2006; Taraban et al., 2004). Reading to learn requires students to practice purposeful reading to execute a specific learning task. This assumes that students have a clear reading goal in mind while simultaneously monitoring the relevance of information to reach their goal. This type of reading is also known as task-oriented reading (Vidal-Abarca et al., 2010; Anmarkrud et al., 2013).

Teaching task-oriented reading seems a promising avenue to aid students in their attempts to reading to learn. In the literature about task-oriented reading, the process of task-oriented reading has been researched extensively (Vidal-Abarca et al., 2010; Cerdán et al., 2011; Cerdán et al., 2019; Salmerón et al., 2015; Vidal-Abarca et al., 2011). There are a few intervention studies with the aim to foster task-oriented reading (Serrano-Mendizábal et al., 2023; Serrano et al., 2018), but those studies are not set in realistic classroom settings, in which teachers play a central role and use reading materials of their own choice. In contrast, the aim of the present study is to design and test a learning environment in realistic classroom settings to foster task-oriented reading in higher education. As the goal of task-oriented reading is to acquire disciplinary knowledge about course contents, we collaborated with the teachers of these courses to adapt the intervention to the course requirements, using study materials and learning objectives that the teachers had selected. As a result, these teachers who typically do not identify themselves as 'reading or language teachers', had to pay attention to the role of reading in arriving at the learning objectives set.

1.1 Task-oriented reading

Task-oriented reading can be defined as an adaptive problem-solving process in which readers use parts of texts based on their relevance for a specific learning task. In past research, a lot of attention has been given to the importance of text representation, however, the reading task itself can pose a challenge for reading to learn. Thus, text representation (Kintsch, 1986) and task representation need to be connected (Britt et al., 2017; Cerdán et al., 2008; Rouet, 2011). In higher education, students are challenged to integrate more and more complex information, often in a short period of time, requiring the ability to efficiently search and select text parts that are relevant for the given learning task. The MD-TRACE model (Multiple Documents Task-Based Relevance Assessment and Content Extraction) (Rouet, 2011), specifies the process of task-oriented reading, in which readers need an understanding of the task demands

(Cerdán et al., 2019; Tawfik et al., 2020) (Cerdán, 2019; Tawfik, 2022) to create a task representation, and to study multiple texts to create a text representation. While doing so, readers monitor their understanding of the text by using their background knowledge. Simultaneously, readers need to update their task representation to evaluate whether the information discussed in the text is relevant for completing the learning task. This process is cyclical and goes on until the reader decides that sufficient information has been gathered. Likewise, a preliminary task product is created and updated in a cyclical manner, until the reader decides that the task product meets the learning task objectives.

In a more recent task-oriented reading model, Rouet et al. (2017) proposed Reading as Problem Solving (RESOLV). In this model, attention is given to the context and the task representation that readers construct before engaging with texts. In RESOLV, contextual factors are more explicitly defined that moderate the task representation of readers. For example, the verbal instructions given by the teacher, the given time in which the task should be performed, and the reading self-concept of the student might influence how a student approaches the learning task and which resources the reader has at his disposal. This means that each student in a class may set different goals and therefore utilizes different task approaches for the same learning task. For example, students who lack background knowledge, may choose to read the whole text first before looking at questions that accompany the text, while for students with more background knowledge, it may be more efficient to read the questions first and then search for relevant information in the text. In sum, task-oriented reading models such as MD-TRACE and RESOLV propose that reading is a purposeful activity in which readers need to make decisions concerning their reading approach to attain the learning goals they themselves set, within the context of a given learning task.

Research showed that the task approach of readers is influenced for a large part by the specific formulation of learning tasks at hand (Cerdán et al., 2011; Hautala et al., 2022; Salmerón et al., 2017; Salmerón et al., 2015). Depending on the goal of the learning task, readers adapt their task approach to reach that goal. For instance, the amount of initial reading (before looking at questions), the number of searches for relevant text parts and monitoring comprehension are self-regulatory activities that contribute to the quality of task-oriented reading (Vidal-Abarca et al., 2010; Anmarkrud et al., 2013; Cerdán et al., 2009; Mañá et al., 2017; Salmerón et al., 2015). While task-oriented reading is approached as an individual process in the research base, there is ample reason to emphasize the role that collaboration can play in facilitating task-oriented reading processes. In discussions between students in small groups, active learning is promoted (e.g., De Backer et al., 2015; Prince, 2004; Wong and Chapman, 2023) and enables students to confront perspectives with each other and discuss reasons for selecting relevant information from their texts. One of the most promising approaches for collaboration in class is known as reciprocal teaching.

1.2 Reciprocal teaching and scripted collaboration

Reciprocal teaching (Palincsar et al., 1987; Palincsar and Brown, 1984) is a widely used method of instructing and guiding students in reading comprehension, that yielded positive results (Kelly et al., 1994; Rosenshine and Meister, 1994; Spörer et al., 2009). In this method, students take on the role of the 'teacher' and engage in using reading strategies (e.g., predicting, questioning, clarifying and summarizing) while reading a text in a small group, guided by an adult tutor. The

reciprocal aspect comes into play as students take turns leading the discussion. By actively participating, students' own learning process is fostered and students benefit from the insights and perspectives from other group members. When combined with the framework of task-oriented reading, discussions about texts are supplemented by the explicit requirement of finding agreement among members about their task-representation. In our study the focus is on discussions around finding a common task-representation and relevant text information instead of the more traditional use of reciprocal teaching which focusses more on strategies for text comprehension.

Earlier research into the effects of reciprocal teaching in classroom contexts has shown that it is extremely difficult for teachers to keep track of the work of different collaborating groups in class (Hacker and Tenen, 2002; Okkinga et al., 2021). While positive effects of reciprocal teaching in previous research are achieved in situations in which each group is guided by an adult tutor, this is hardly feasible in educational practice. Therefore, it is important that other forms of scaffold are being used as guidance for students in their collaboration process in regular classroom contexts.

In scripted collaboration, instructions are given in a (usually digital) learning environment to structure the group discussion (Fischer et al., 2013; Kollar et al., 2006). Important elements of such scripts are that group members are assigned different roles (as in reciprocal teaching) for which the script provides specific instructions and that students follow specific sequences (phasing) of actions (so-called "scenes," see Fischer et al., 2013) to arrive at a satisfactory outcome.

Previous research has demonstrated that the appointment of a leader or chairman and a writer or summarizer has positive effects on learning outcomes and cooperation (Schellens et al., 2007; Strijbos and Weinberger, 2010). In addition, studies into guiding students by phasing of the group discussion show positive effects on the acquisition of domain specific knowledge and on the quality of cooperation (Radkowsch et al., 2020; Schoonenboom, 2008; Vogel et al., 2017) and on students' task representation (Kielstra et al., 2022). For example, Papadopoulos et al. (2013) found that students who collaborated with a mandatory script acquired more domain specific knowledge and also cooperated more with each other than students who had to complete the task with a less mandatory script. In the first case, students had to first explicitly formulate their own answers for a task before consulting with each other about a joint answer, while in the second case this was left up to themselves.

Thus, to alleviate the burden on teachers from managing content-related discussions among multiple groups simultaneously, scripted collaboration offers a viable alternative. Therefore, in addition to finding general effects of our learning environment for task-oriented reading, we also try to find out in this study to what extent phasing (including role assignment) leads to better task-oriented reading of students than just role assignment.

1.3 Present study

This study aimed to design¹ and test a technology-enhanced learning environment (TELE), aiding teacher education students in

authentic classroom contexts in the process of task-oriented reading in two stages: homework and group discussion.

An experiment was carried out in which effects of "phasing" (PH) of the discussion part of the intervention on students' task-oriented reading (answering open questions about multiple texts) were compared to a "role assignment only" (RAO) condition that did not receive support for the phases to complete in the group discussion (Kollar et al., 2006). The learning environment for the RAO condition was identical to that for the PH condition in all other respects.

The research questions were:

1. Does utilizing the learning environment enhance the quality of task-oriented reading in teacher education students of different disciplines?
2. Does phasing (including role assignment) lead to more improvement in task-oriented reading performance compared to role assignment only?
3. Are there differences in the task approach between students in the two experimental conditions?
4. How do both teacher education students and teachers evaluate the learning environment?

2 Method

2.1 Participants and design

In total 105 third-year teacher students (61% females, $M_{age} = 23.29$ years) from the Rotterdam University of Applied Sciences participated in the study. They were enrolled as teacher students for secondary education for the disciplines economy, biology, physics, English as a foreign language or social sciences. Eighty-eight students completed both pre- and posttest.

A pre-post experimental design was utilized. Students, within classes, were randomly assigned to the PH condition or RAO condition. Within each class, groups of ideally four students were formed to participate in the group discussions, either belonging to the PH or the RAO condition. The formation of the groups after randomization of individual students was done by the teacher.

2.2 Materials

2.2.1 Technology-enhanced learning environment (TELE)

The TELE contained three modules: The homework module, the group work module, and the test module (see 2.2.2). In the homework module students worked individually preparing for the group discussion. The group discussion module was used during classes, in both conditions. The test module was devised to analyze the students' use of task-oriented reading in the pre- and the posttest.

¹ The learning environment was piloted in two waves. The first wave concerned a 'paper and pencil' pilot in which two classes participated. In the

second wave, a prototype of the learning environment was piloted in classes of two different disciplines.



FIGURE 1
Screenshot of the tabs in the Homework module, with on the left column two tabs to go to 'Home' or to go to the homework questions. In the middle column the tabs for explanation of the homework (in blue), the group assignment, explanation of different roles and the reading strategies. In this example the general explanation of the homework is selected, which can be seen on the right side of the screen.

2.2.1.1 Homework module

Before each lesson, the roles of each student in the group were determined (leader, writer, thinker). As part of their homework, the students were instructed to study the assigned text(s) in preparation for the corresponding group task. They were encouraged to actively seek relevant information in the text(s) necessary for completion of the group assignment. Accessing the Homework module (See Figure 1) on their device, they found the following components:

- 1. A main screen providing general instructions for each group task. Students were required to underline relevant sections in the study texts for this week's group task.
- 2. A tab containing the group task for the current week.
- 3. A tab offering general explanations for the roles of leader, writer and thinker.
- 4. A tab providing explanations about four reading strategies: skimming, scanning, paraphrasing and intensive reading.
- 5. A tab to access the homework questions. There were four homework questions focused on reflecting on the students' task approach, and finally the most essential question: What is the most important information from the text that you want to bring to the group discussion?

2.2.1.2 Group discussion module

During class, students brought their study texts (which were always provided on paper) and devices. The teacher initiated the lesson and instructed students to sit in their assigned groups. The teacher explained the group assignment and invited questions from the class. Subsequently, students worked collaboratively in their groups. The main focus was for students to share relevant information they had extracted from the text (previously underlined in their study

TABLE 1 Overview of similarities and differences between PH and ROA conditions.

Phasing (PH)	Role assignment only (ROA)
Role assignment: leader, writer, thinkers	Role assignment: leader, writer, thinkers
In each phase, the different roles received different instructions	Overall instructions for each role
Exchanging experiences during homework Discuss relevant text passages for the task at hand Formulate a draft version of the group solution Revise draft version into a definite solution	Group decides their task approach themselves
Evaluate collaboration process	Evaluate collaboration process

texts) and discuss how to apply that information to complete the group assignment.

Ideally, each group consisted of four members, including a chairperson, writer, and two thinkers. However, group sizes varied based on the number of students present. Roles rotated throughout the lessons, ensuring each student assumed each role at least twice. Group discussions typically lasted between 30 and 45 min per lesson.

The level of support differed between the Phasing (PH) and Role Assignment Only (RAO) conditions, as presented in Table 1. In the PH condition, students followed specific phases with instructions tailored to each role's objectives. In the RAO condition, students had the freedom to determine their own approach to the group assignment. After all groups completed and submitted their solution

TABLE 2 The six different types of group assignments, with examples.

Type of group assignment	Example
Answering study questions This type of assignment is suitable for long and complex texts. The type of questions should be inferential, interpreting or reflecting in nature, allowing students to formulate their own answers and not relying solely on literal information in the text.	- According to the text, what are disadvantages of climate change? - Which countries will encounter the implications of climate change first, and why?
Summarizing A specific question and/or audience for the summary makes it clear which information should be included (and which should be discarded).	What are the main conclusions of the climate panel on the future of the earth?
Comparing texts By comparing text contents with another text about the same subject, reflecting on similarities and differences is encouraged.	How do the two texts differ when it comes to assessing the dangers of climate change?
Mind map A mind map is a hierarchical representation of the text, used to visualize relationships between important concepts.	Create a mind map of factors that cause climate change.
Construing (exam) questions To come up with questions about the text, the student must have a good overview of the text. It challenges the students to think like their teacher ('what could the teacher ask on the exam?').	Come up with an exam question about the text. Compare exam questions with each other in the group. Select the two that are best and argue why.
Applying knowledge The goal of this assignment type is to apply learned contents to a real-life situation.	Compare the newspaper article about the Maldives with what you learned about climate change. Are the problems on the archipelago the result of this? Explain your answer.

The examples given are fictitious. The assignments actually used in the intervention cannot be understood without the accompanying texts from each discipline.

to the group assignment, the teacher conducted a whole-class review. The solutions for the group assignment were projected on a screen, allowing the students to explain their responses, encouraging peer feedback, and providing instructor feedback on the completed group assignments.

2.2.1.3 Types of group assignments

A total of six types of group assignments were developed for six lessons. While the types of assignments were predetermined, their specific implementation varied across the different disciplines, adapting to the unique subject matter covered in each content course. The formulation of the group assignments was established through a collaborative process with the teachers prior to each lesson series. Table 2 provides a comprehensive overview of the types of group assignments, accompanied by an illustrative example focusing on the topic of climate change. It was crucial for the group assignments to evoke extensive discussions, thereby necessitating

that the answers were not literally stated in the text. Students were encouraged to engage in thoughtful deliberations on how the provided text could be effectively utilized to fulfill the objectives of the group assignments.

The first group assignment entailed responding to study questions about the text, a format that was familiar to both students and teacher. Subsequent group assignments were more complicated, demanding students to engage in higher-order thinking, making inferences and establishing connections, both within and between the assignment and the text(s). The sequencing of these group assignments was determined in consultation with the teacher, aiming at an optimal progression of the lessons and the accompanying study texts.

2.2.2 Task-oriented reading tasks for pre- and post-test

Two task-oriented reading tasks (pre- and post-test) were designed, each consisting of four texts and 11 open-ended questions about these texts. For each correct answer one point could be earned. To ensure comparability between the pre- and post-test in content and difficulty, we equalized the number and total length of the texts (2,520 and 2,634 words respectively) and the time allowed for answering (1 h). Both tests included texts from the same content domain (climate change) to minimize the influence of background knowledge and to ensure relevance for students from all four disciplines (economy, biology, history, and social sciences).

The reading tasks were presented in the Test module of the TELE, specifically designed to log not only the answers given on each question but also actions students performed during the tasks, analogous to the Read&Answer software (Vidal-Abarca et al., 2011). The procedure for reading (unblurring) and answering questions was identical in both tests.

The 11 open-ended questions were based on the PISA taxonomy (reproduction, interpretation, reflection), with the frequency of each question type being the same in both tests. For example, "Name two economic and two ecologic consequences of global warming" (reproduction), "Based on historical research, what kind of climate would you expect during political flourishing times and periods of economic growth?" (interpretation), and "What is the most important conclusion you can draw about the role of government and companies in climate change?" (reflection).

For several questions, within each task, the students were required to consult multiple texts in order to give a correct answer (e.g., "Some people hold humans accountable for climate change. What are, according to you, the three most important arguments against this view, based on the texts?"). The questions were ordered randomly; they were not clustered based on question type or order of the texts. Students were required to rely on self-regulation to search for relevant information, based on the questions and on the layout of each text.

Answers to all questions were scored by two coders. Interrater reliability was good with Pearson $r = 0.88$, $p < 0.001$, for the total score of the pretest and Pearson $r = 0.86$, $p < 0.001$ for the posttest. Disagreements in coding were resolved through discussion among the coders.

2.2.3 Task approach during task execution

By blurring text parts and questions, it was possible to log each individual's reading and answering behavior including time spent to each. Students had to unblur text parts (see Figure 2 for an example),



TABLE 3 Overview of variables extracted from the log files.

Variables	Explanation
Percentage time relevant text parts	The percentage of total time a student spent on looking at relevant text parts.
Ratio relevant/irrelevant text parts	The time spent on irrelevant text parts divided by the time spent on relevant text parts. A value greater than 1 indicates that students relatively spend more time on relevant than irrelevant parts of text.
Total time question reading	The total time spent on the questions (in seconds).
Total frequency question reading	The total number of times the questions were viewed.
Average frequency reading the same question	The average number of times the same question was viewed. A value greater than 1 indicates that students have viewed the same question multiple times.
Total time question answering	The time spent answering the questions (in seconds).

questions and their answers in order to be able to read the text parts or the questions, or to be able to write or revise answers. Students were free to choose how they approached the task by either opening a text or opening a question. The layout of the texts was visible, as well as each title and all subtitles. Blurring was done at the paragraph level. We also assessed whether the text parts students examined were relevant for answering the questions. Ultimately, we extracted variables indicative of students' task approaches from their log files (see Table 3).

2.2.4 Evaluation by students and teachers

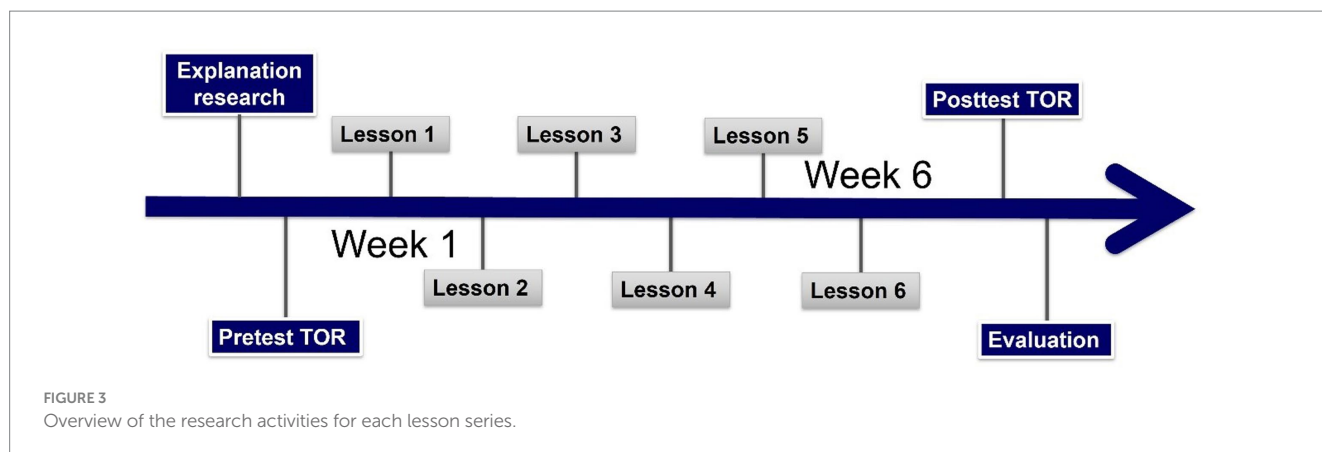
Students were asked to participate in a focus group, to be organized after the posttest. For each course, 4–6 students were willing to participate, with approximately equal participation from both conditions. Teachers were not present during the focus group sessions.

The goal of the focus group was to gather the opinions of students concerning different aspects of the learning environment. A total of 8 interview themes were identified for which questions were formulated. The same themes were used for the interview with the teachers. We asked questions about the homework module, role assignment, group discussions module (and the different versions for each condition), the group assignments, collaboration within discussion groups, prerequisites for collaboration, the difficulty of the reading tasks (pre- and posttest) and students' general opinion of the course and the instruction of their teacher.

Each focus group lasted for an hour. Students received a voucher of 10 euro for their participation in the focus group. Interviews with the individual teachers took place after the focus group of their course and lasted between 20 and 40 min.

2.3 Procedure

Prior to the lessons, participating teachers, in collaboration with the researchers, formulated assignments for students to solve, according to the six types in Table 2. The lesson series lasted 6 weeks, with one 90-min lesson per week (see Figure 3). Thus, the total intervention duration was 9 h. Prior to the first lesson, the students of each course were given an explanation about the research and were given a Chromebook on which the TELE ("Reading App") could



be downloaded, and a paper copy of the texts needed for the course. This copy was used in their homework for underlining relevant passages and making notes. In addition, students were given an explanation of the importance of task-oriented reading, the roles during the group discussions, the four reading strategies and practical information about the learning environment and the tablet. The students in each class were randomly assigned to either condition. Students were unaware of the differences between the two conditions (PH or ROA); they were only told there were two versions (A and B). All students were asked to sign a license agreement for the use of the Chromebook during the course and they were asked to sign for informed consent for data collection.

In the subsequent session, the pretest was administered. This was followed by six lessons with the group assignments and the learning environment, which were interspersed with regular lessons from the teacher (which were not part of the intervention).

The first author or a student-assistant were present during all lessons to safeguard that the lessons proceeded as planned and give technical support when necessary. The observations of all lessons have shown that students in discussion groups did not interfere with other students while working on their group assignments. Therefore, the risk of a “spill over” effect between conditions is negligible.

In the last session, the posttest was administered. Students were allowed to complete both pretest and posttest within an hour. Finally, the focus groups were held and teachers were interviewed about their experiences. For an overview of research activities across time, see Figure 3.

2.4 Ethical considerations

Written informed consent was collected from all participants. Focus interviews were recorded with participant permission.

2.5 Analyses

Analyses were done with repeated-measures ANOVA, with condition (PH and RAO) as factor. Dependent variables were the percentage of correct answers and task-approach activities in the pre- and post-test during task execution (see Table 3).

3 Results

3.1 Statistical analyses

In Table 4, results of all analyses are presented, together with descriptive statistics for each variable and condition. To examine whether utilizing the learning environment enhanced students’ task-oriented reading skills (research question 1), a repeated-measures ANOVA was performed with the percentage score² of the task-oriented reading task as dependent variable. Overall, students performed significantly better on the posttest compared to the pretest ($\eta^2 = 0.13$). Second, by adding Condition as factor to the repeated-measures ANOVA (research question 2), we examined whether the Phasing condition (PH) helped students improve their task-oriented reading to a greater extent than the Role Assignment Only condition (ROA). The interaction effect was not significant ($\eta^2 = 0.004$), suggesting that the PH condition did not benefit more than the ROA condition (see Figure 4).

For the variables concerning task approach (research question 3), all effects over time were significant but the interaction effects for condition were not statistically significant. Students on average spent significantly more time to relevant text parts in the posttest than in the pretest ($\eta^2 = 0.33$). In the pretest, students spent on average 35% of their total time to relevant text parts, while this was 54% at posttest. The same pattern holds for the ratio of relevant/irrelevant text parts in pre- and posttest ($\eta^2 = 0.44$), see Figure 5. In addition, students spent on average significantly less time on question reading in the posttest compared to the pretest ($\eta^2 = 0.43$) (see Figure 6) and the number of times questions were consulted was significantly lower at posttest than pretest ($\eta^2 = 0.14$). Lastly, students spent significantly less time on answering questions in the posttest compared to the pretest ($\eta^2 = 0.43$). This is remarkable, because it means that the students formulated better answers in less time on average in the posttest compared to the pretest.

² Although pre- and posttest had an equal number of questions, there was a difference in the maximum number of points to be gained. We corrected for this difference by calculating the percentage of correct answers.

TABLE 4 Results of repeated-measures ANOVA for all variables, with means and SDs per condition (Phasing (PH) and Role Assignment Only (RAO)).

Variable	Pretest		Posttest		Repeated-Measures ANOVA			
	PH Mean(SD)	RAO Mean(SD)	PH Mean(SD)	RAO Mean(SD)	Effect	<i>F</i> (1, 77)	<i>p</i> -value	η^2
Percentage score task-oriented reading	0.47(0.14)	0.50(0.15)	0.55(0.15)	0.55(0.15)	Time	11.489	0.001	0.13
					Time x Condition	0.338	0.562	0.004
Percentage relevant text parts	0.38(0.38)	0.32(0.06)	0.55(0.12)	0.53(0.11)	Time	33.62	<0.001	0.304
					Time x Condition	0.38	0.539	0.005
Ratio relevant/irrelevant text parts	0.91(0.25)	1.01(0.40)	1.38(0.46)	1.52(0.56)	Time	60.72	<0.001	0.441
					Time x Condition	0.75	0.388	0.010
Total time question reading	285.75(94.01)	271.16(94.70)	211.10(77.12)	191.07(70.93)	Time	58.81	<0.001	0.43
					Time x Condition	0.73	0.788	0.001
Total frequency question reading	48.29(16.97)	47.31(18.60)	41.66(14.63)	40.16(16.59)	Time	12.88	0.001	0.143
					Time x Condition	0.295	0.589	0.004
Average frequency reading the same question	4.48(1.60)	4.28(1.72)	3.77(1.41)	3.75(1.50)	Time	12.88	0.001	0.14
					Time x Condition	0.294	0.589	0.004
Total time question answering	796.90(265.22)	874.19(307.02)	577.84(284.95)	669.02(309.77)	Time	65.953	<0.001	0.461
					Time x Condition	0.679	0.412	0.009



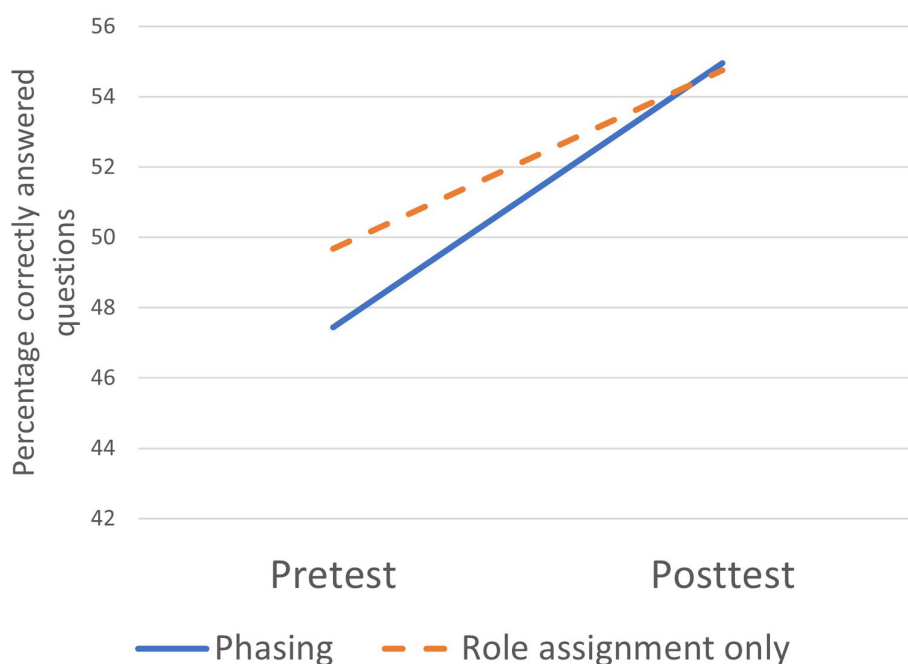


FIGURE 5
Percentage of relevant text parts consulted, for each condition.

3.2 Evaluation by students and teachers

To answer research question 4, the interview data from both teachers and students were inspected, after which five relevant themes emerged: engagement (in group discussions), role assignment, different types of group assignment, prior knowledge activation, and teacher feedback.

3.2.1 Engagement in discussion groups

Students mentioned that their participation in discussion groups encourages them to approach their reading of course materials with more critical awareness. One student expressed this sentiment, stating, “I often interpreted things quite differently, and my classmate would suggest alternative interpretations. So, I found it quite useful, especially in terms of improving reading comprehension, which is not emphasized as much these days. It makes me more mindful of what I’m reading.” Another student emphasized that by being confronted with the opinions of other students about the texts, their thinking was challenged: “What I find strong about it is that you start actively thinking: how am I going to approach this myself? And you also hear things like getting irritated by [another student], totally disagreeing, but it does affect you. It triggers you, which makes you engage actively.”

Students also noted that the learning environment helped them coming to class better prepared, and teachers observed more depth in discussions. A student commented, “This approach pushed us to be more actively engaged with the material. Otherwise, I would have started engaging with it much later. So, I think it’s a great teaching method that I can use in my future lessons as a social studies teacher.”

3.2.2 Role assignment

Students found that the roles were particularly useful during the first two lessons as they made clear that every member in the group had a specific contribution to the discussion and they did not need to

spend time on discussing how to proceed. One student remarked: “Yes, I liked it [the different roles]! I think maybe the roles were not always followed, but that happens sometimes. If not everyone is there, you just have to improvise a bit. But I do think it’s very good. It’s definitely easier to do those group assignments when the roles are included.”

Students mentioned that the roles became more fluid as the lesson series progressed. For instance, one student mentioned that he liked the role of leader and thus stepped into this role more often, even if he was supposed to be a thinker. Regarding the experimental conditions, students in the focus groups reacted surprised when it was revealed what the difference was between the two conditions (‘versions’ for the students); they thought the two versions were similar and had not noticed this difference while working in class.

3.2.3 Different types of group assignments

Students appreciated the different types of group assignments (“I enjoyed doing a different assignment each time”). Many comments were made about the mind map assignment, the opinions differed from (too) difficult and not enjoyable to very enjoyable and useful. Three students reacted to each other about the usefulness of creating a mind map:

Student 1: “I thought that one [mind map assignment] was really good. I also enjoy creating a mind map myself. It’s just so clear, and when I was studying, I could just go back to that mind map and look at it for a moment. And for that chapter, a mind map was really useful.”

Student 2: “Yes, it also really fit well with that chapter. And it’s more like—what I created a mind map for, I remembered much better, and I still do. Things I just underlined have already faded a bit.”

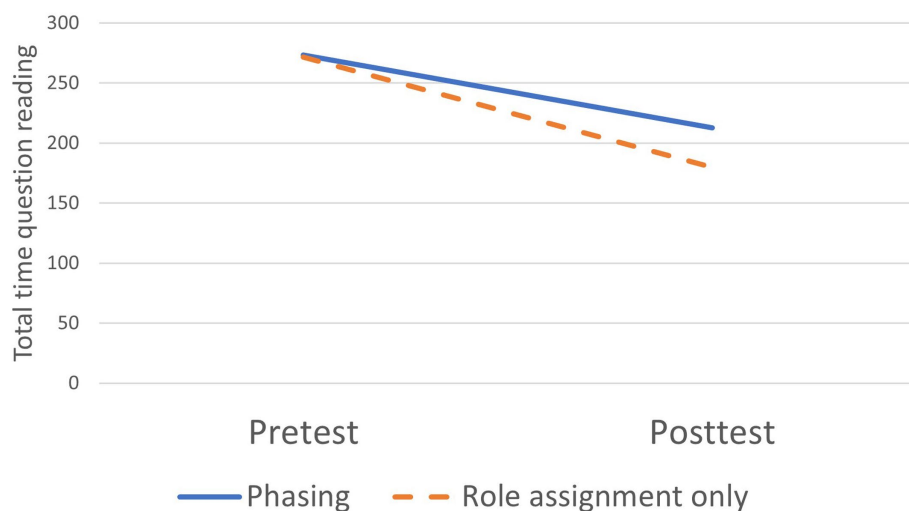


FIGURE 6
Total time question reading (in seconds), for each condition.

Student 6: “Yes, I also notice that with the mind map—you really had to study the text thoroughly first. It wasn’t a task where you could just skim the text; it was really like, ‘What’s important in the text? List everything.’ So, you really had to dive deeply into it.”

Two assignments were often regarded as difficult: the comparing of texts and the application of knowledge. One student remarked: “There was one assignment where we had to compare two texts—find two similarities and five differences—and I found that really difficult. I could see a similarity, like that they both talk about diversity and such, but I did not know if that was what they actually meant. I found it a bit of a tough assignment because you had to compare two texts that were really quite different. It was really the kind of task where I thought: oh no, I do not even know what I’m doing right now or if it’s correct. I really got stuck for a moment because I did not know where to look or what to focus on. But when we eventually discussed it in class, it went better. Still, at the time I found it quite a challenging assignment.”

3.2.4 Prior knowledge activation

Both teachers and students raised concerns regarding specific aspects of the learning environment. Students mentioned difficulties in connecting the contents of the texts with their prior knowledge. This may hamper their attempts to contribute meaningfully to group discussions. In addition, preparatory activities in the homework module often remained somewhat superficial according to the students. However, teachers observed a marked difference in preparation compared to previous cohorts in which the learning environment was not part of the lesson series, which is corroborated by one of the students, who said: “Normally, with a different course, I do not do any homework or preparations, because you do not need it in class.”

3.2.5 Teacher feedback

Teachers faced challenges in providing detailed feedback on group work, especially when dealing with complex tasks like formulating solutions to intricate problems or comparing different texts on the same subject. Teachers found it demanding to give immediate

responses to students’ answers to group assignments and to foster in-depth classroom discussions on them. Consequently, the feedback provided by the teachers tended to be not very informative for students to decide how to approach the group assignments that followed. It is therefore not surprising that students expressed their desire for more specific feedback on their work on the group assignments. For instance, one student remarked, “We were largely left to our own devices. What seems effective is when the teacher joins the groups without assuming an authoritative role but instead asks, ‘What progress have you made? What conclusions have you reached?’” Another student added, “Additionally, [the teacher] should pose questions not only to the group leader but to every member, like ‘What are your thoughts on this section?’”.

Other students mentioned they would appreciate it if the teacher would give feedback on whether their answers were correct or incorrect, especially when the group was struggling with the assignment “And if it’s not properly discussed by the teacher, then you still do not know what the correct answer is.” Some students made suggestions on how it would be easier for the teacher to give proper feedback, for example by not giving feedback immediately after the group discussion, but giving feedback in the next lesson.

3.2.6 Conclusion

Findings from the focus groups with students and interviews with their teachers revealed a notable satisfaction among both educators and students regarding the division of roles within discussion groups and the addition of group assignments during class sessions. One student even said: “Yes, we really could have used that learning environment more often in our studies. It’s super useful for so many assignments.”

4 Discussion

This research aimed at testing the effects of two types of scripted collaboration in a learning environment to enhance students’ task-oriented reading skills in higher education. Previous

research convincingly showed that task-oriented reading (Vidal-Abarca et al., 2010) is an important element of reading-to-learn in individual reading behavior (Anmarkrud et al., 2013; Cerdán et al., 2009; Mañá et al., 2017; Salmerón et al., 2015). In addition, intervention studies for facilitating task-oriented reading have been focused on individual learning outside the classroom context. In contrast, our study attempted to test an intervention in an ecologically valid setting, namely regular classroom contexts in teacher education, in which not only the researchers but also teachers in different disciplines acted as important participants. The design of the intervention drew on the principles of reciprocal teaching (Palincsar and Brown, 1984), task-oriented reading (Vidal-Abarca et al., 2010), and scripted collaboration (Kollar et al., 2006) to foster student engagement in discussions directed at task and text representation. A key aspect of the intervention was the reading of assigned study materials prior to the group discussions. Following the group discussions, the teacher provided feedback for the different results of the groups in class.

The findings of this study provide clear indications that implementing the intervention across a series of six lessons for different subjects in teacher education programs yields positive outcomes. Significant improvements were observed in both the quality of question answering and several aspects of the students' task approach. Notably, the answer scores on the post-test were substantially higher than those on the pre-test, and students demonstrated increased attention to relevant text parts during the post-test, and in general appeared to use a more efficient approach in the post-test. The results suggest that students exhibited greater efficiency in navigating between their task and text representation, which is in accordance with literature on the process of task-oriented reading. Students devoted more time to studying relevant sections of the text while allocating less time to irrelevant sections and understanding the questions, which is in line with the finding that more efficient readers allocate their reading time more to relevant paragraphs than to irrelevant paragraphs (Cerdán et al., 2011; Hautala et al., 2022; Yeari et al., 2015). Moreover, students gained a clearer understanding of the task requirements during the post-test, as is shown by the reduction of time (and frequency) spent on comprehension of the questions and formulation of the answers. Finally, the evaluations of both teachers and students at the end of the lesson series revealed a high level of appreciation for the intervention.

On the other hand, no significant differences were found between the two types of scripting, indicating that the phased discussion (PH condition) did not confer any advantage over role assignment only. Possibly, phased instructions were too complex for the students to make use of. This is in contrast with earlier studies, which suggest that phasing does have a positive effect on learning (e.g., Papadopoulos et al., 2013; Radkowsch et al., 2020; Schoonenboom, 2008; Vogel et al., 2017). This difference may be attributed to the relatively small difference between the two types of scripting, as the distinguishing factor in the PH condition was the provision of phase-specific instructions for each role during the group discussions. However, both conditions received identical group assignments, study materials, role assignment, and post-discussion feedback of the teacher and acted within the same classroom.

It could be suggested that over-scripting played a role (Dillenbourg, 2002). Over-scripting occurs when the structure

provided during the collaborative process becomes a barrier instead of a facilitator. In the case of our script, it might be that students experienced cognitive overload, as each role received detailed instructions in each phase of the script. For instance, the leader received instructions about the goal of the first phase and example prompts to stimulate discussion among the team members (e.g., 'what was your reading approach for the study text?'). Contrary to this assumption, students in the phased condition did not show poorer results in the individual task-oriented reading task at posttest. This is in line with the meta-analysis of Belland et al. (2017), investigating the effects of computer-based scaffolding in higher education. Their conclusion was that "over-scripting may not occur or does not negatively affect cognitive outcomes" (Belland et al., 2017, p. 331). Nevertheless, this issue might be interesting to explore in future research.

Based on the interviews conducted with students and teachers, two key areas for improvement of the learning environment emerged: the first concerns the importance of activating prior knowledge during homework preparation. Activating prior knowledge plays a significant role in reading comprehension (Ahmed et al., 2016; Elbro and Buch-Iversen, 2013; McCarthy et al., 2018), as well as in problem-solving tasks that require accurate monitoring of comprehension (Mihalca and Mengelkamp, 2020). However, research has shown that teachers often do not pay enough attention to this aspect of their instruction (Hattan and Alexander, 2020; Hattan et al., 2015). Therefore, the learning environment could be enhanced by including specific directions in the homework module to make students aware of their prior knowledge on the topic and how this knowledge relates to what they are studying. Teachers may also need to be made aware of the role of prior knowledge in conceptual knowledge learning (Heinonen et al., 2023).

Secondly, the quality of the feedback by the teachers is an area for improvement. Students stated they would have benefitted more from a teacher who has the role of facilitator in their learning process. High quality feedback makes a significant contribution to learning. However, in practice educators find it challenging to provide effective feedback (Hattie and Timperley, 2007). In many cases feedback remains limited to right/wrong judgments (Wijekumar et al., 2021), which does not encourage students to develop a deeper understanding or engage actively with learning tasks. A training for teachers in how to engage in a dialogue with their students and challenge them to deepen their understanding through thought-provoking questions could become a valuable addition to the present learning environment (Beck et al., 1996; Buchanan Hill, 2016).

4.1 Limitations

A limitation of this study concerns the pre-test and post-test, as the two tests consisted of different texts and questions. This introduces the possibility that the observed effects cannot be solely attributed to growth in task-oriented reading skill but may also be the result of a different test difficulty. Although the two tests were comparable in other important respects (content domain, question taxonomy, open-ended question format, administration procedure, and total text length), and we have no indications that there is a difference in difficulty. Future research could employ a counterbalanced design

where the pre-test and post-test are randomly assigned to students, with half of the students receiving Test A as the pre-test and Test B as the post-test, and vice versa. Despite this limitation, the findings strongly suggest growth in task-oriented reading skills, with the observed differences in task approach during the tests further supporting this interpretation.

Furthermore, it should be acknowledged that the results of this study may not generalize to other institutions, disciplines, or cultural contexts. Reading practices and educational approaches can differ considerably across settings, which may affect the outcomes of task-oriented reading interventions. Replication in diverse contexts is needed to confirm the robustness of our findings.

4.2 Implications for practice

Based on this research, it is important for teachers to recognize the task-oriented nature of reading-to-learn, focusing not only on the text contents but also on how they relate to the learning task at hand. This requires carefully crafted task instructions that, on the one hand, align with the educational learning objectives and, on the other, invite discussion among the students. Our experiences with the teachers formulating group assignments for our discussion groups showed that they found it quite difficult to come up with group assignments that met these requirements. This poses a risk for the effectiveness of the learning environment in educational practice. It is therefore recommended that teachers receive training. This training should focus on how to formulate learning assignments that provoke dialogues and discussion, how to guide students in their discussions and how to provide dialogic feedback, adjusted to their student population. Since a technology-enhanced learning environment might not be feasible in every educational setting, the learning environment can be accommodated to a paper-and-pencil one. Explanations about the different roles (leader, thinker, writer) can be given orally and on paper, as well as the group assignments. The most difficult part to transfer to a paper-and-pencil setting is the phasing. As our results currently suggest, this part of the learning environment might not have moved the needle in enhancing task-oriented reading. It remains to be seen, however, whether this result can be replicated in other educational contexts, for example in primary or secondary education.

In conclusion, the combination of the didactic principles of reciprocal teaching, task-oriented reading and (scripted) collaboration has shown to be promising to enhance task-oriented reading. Both teachers and students showed a high level of appreciation for the learning environment. The learning environment might become an excellent tool that stimulates students to take an active role in their learning process and to acquire task approaches that guide them to use complex study texts effectively and efficiently.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval were not required for this study because the study involved started in 2015 under the responsibility of Rotterdam University of Applied Sciences. At that time, there was no IRB at the Rotterdam University of Applied Sciences and no regulations entailing approval and informed consent. Written informed consent was collected from all participants, even though there was no IRB at the time to mandate this process. Focus interviews were recorded with participant permission. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

MO: Conceptualization, Formal analysis, Methodology, Visualization, Writing – original draft, Writing – review & editing. AV: Conceptualization, Funding acquisition, Investigation, Project administration, Supervision, Validation, Writing – review & editing.

Funding

The author(s) declare that financial support was received for the research and/or publication of this article. This research was supported by a RAAK-PRO grant from Taskforce for Applied Research SIA, grant number: 2014–01–32PRO.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The authors declare that no Gen AI was used in the creation of this manuscript.

Any alternative text (alt text) provided alongside figures in this article has been generated by Frontiers with the support of artificial intelligence and reasonable efforts have been made to ensure accuracy, including review by the authors wherever possible. If you identify any issues, please contact us.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

- Ahmed, Y., Francis, D. J., York, M., Fletcher, J. M., Barnes, M., and Kulesz, P. (2016). Validation of the direct and inferential mediation (DIME) model of reading comprehension in grades 7 through 12. *Contemp. Educ. Psychol.* 44–45, 68–82. doi: 10.1016/j.cedpsych.2016.02.002
- Anmarkrud, Ø., McCrudden, M. T., Bråten, I., and Strømso, H. I. (2013). Task-oriented reading of multiple documents: online comprehension processes and offline products. *Instr. Sci.* 41, 873–894. doi: 10.1007/s11251-013-9263-8
- Beck, I. L., McKeown, M. G., Sandora, C., Kucan, L., and Worthy, J. (1996). Questioning the author: a yearlong classroom implementation to engage students with text. *Elem. Sch. J.* 96, 385–414. doi: 10.1086/461835
- Belland, B. R., Walker, A. E., Kim, N. J., and Lefler, M. (2017). Synthesizing results from empirical research on computer-based scaffolding in STEM education: a meta-analysis. *Rev. Educ. Res.* 87, 309–344. doi: 10.3102/0034654316670999
- Berry, T., Cook, L., Hill, N., and Stevens, K. (2010). An exploratory analysis of textbook usage and study habits: misperceptions and barriers to success. *Coll. Teach.* 59, 31–39. doi: 10.1080/87567555.2010.509376
- Bharuthram, S. (2017). The reading habits and practices of undergraduate students at a higher education institution in South Africa: a case study. *Indep. J. Teach. Learn.* 12, 50–62. Available at: <https://journals.co.za/doi/pdf/10.10520/EJC-77dc5a5do>
- Britt, M. A., Rouet, J.-F., and Durik, A. M. (2017). Literacy beyond text comprehension: A theory of purposeful reading. New York: Routledge.
- Buchanan Hill, J. (2016). Questioning techniques: a study of instructional practice. *Peabody J. Educ.* 91, 660–671. doi: 10.1080/0161956X.2016.1227190
- Cerdán, R., Gilabert, R., and Vidal-Abarca, E. (2011). Selecting information to answer questions: strategic individual differences when searching texts. *Learn. Individ. Differ.* 21, 201–205. doi: 10.1016/j.lindif.2010.11.007
- Cerdán, R., Martínez, T., Vidal-Abarca, E., Gilabert, R., Gil, L., and Rouet, J.-F. (2008). “Search and comprehension processes in learning from text” in Understanding multimedia documents. eds. J.-F. Rouet et al. (Boston, MA: Springer), 121–147.
- Cerdán, R., Pérez, A., Vidal-Abarca, E., and Rouet, J. F. (2019). To answer questions from text, one has to understand what the question is asking: differential effects of question aids as a function of comprehension skill. *Read. Writ.* 32, 2111–2124. doi: 10.1007/s11145-019-09943-w
- Cerdán, R., Vidal-Abarca, E., Martínez, T., Gilabert, R., and Gil, L. (2009). Impact of question-answering tasks on search processes and reading comprehension. *Learn. Instr.* 19, 13–27. doi: 10.1016/j.learninstruc.2007.12.003
- Clump, M. A., Bauer, H., and Bradley, C. (2004). The extent to which psychology students read textbooks: a multiple class analysis of reading across the psychology curriculum. *J. Instr. Psychol.* 31, 227–233.
- De Backer, L., Van Keer, H., and Valcke, M. (2015). Promoting university students' metacognitive regulation through peer learning: the potential of reciprocal peer tutoring. *Higher Educ.* 70, 469–486. doi: 10.1007/s10734-014-9849-3
- De-La-Peña, C., and Luque-Rojas, M. J. (2021). Levels of reading comprehension in higher education: systematic review and meta-analysis. *Front. Psychol.* 12:712901. doi: 10.3389/fpsyg.2021.712901
- Dillenbourg, P. (2002). Over-scripting CSCL: The risks of blending collaborative learning with instructional design. In: PA Kirschner ed. Three Worlds of CSCL. Can We Support CSCL?. Heerlen: Open University Nederland, 61–91.
- Doolittle, P. E., Hicks, D., Triplett, C. F., Nichols, W. D., and Young, C. A. (2006). Reciprocal teaching for reading comprehension in higher education: a strategy for fostering the deeper understanding of texts. *Int. J. Teach. Learn. High. Educ.* 17, 106–118.
- Elbro, C., and Buch-Iversen, I. (2013). Activation of background knowledge for inference making: effects on reading comprehension. *Sci. Stud. Reading* 17, 435–452. doi: 10.1080/10888438.2013.774005
- Fischer, F., Kollar, I., Stegmann, K., and Wecker, C. (2013). Toward a script theory of guidance in computer-supported collaborative learning. *Educational psychologist* 48, 56–66. doi: 10.1080/00461520.2012.748005
- Hacker, D. J., and Tenen, A. (2002). Implementing reciprocal teaching in the classroom: overcoming obstacles and making modifications. *J. Educ. Psychol.* 94, 699–718. doi: 10.1037/0022-0663.94.4.699
- Hattan, C., and Alexander, P. A. (2020). Prior knowledge and its activation in elementary classroom discourse. *Read. Writ.* 33, 1617–1647. doi: 10.1007/s11145-020-10022-8
- Hattan, C., Singer, L. M., Loughlin, S., and Alexander, P. A. (2015). Prior knowledge activation in design and in practice. *Liter. Res. Theory Method Pract.* 64, 478–497. doi: 10.1177/2381336915617603
- Hattie, J., and Timperley, H. (2007). The power of feedback. *Rev. Educ. Res.* 77, 81–112. doi: 10.3102/003465430298487
- Hautala, J., Salmerón, L., Tolvanen, A., Loberg, O., and Leppänen, P. (2022). Task-oriented reading efficiency: interplay of general cognitive ability, task demands, strategies and reading fluency. *Read. Writ.* 35, 1787–1813. doi: 10.1007/s11145-022-10265-7
- Heinonen, N., Katajauuri, N., Murtonen, M., and Södervik, I. (2023). Short pedagogical training in supporting university teachers' professional vision: a comparison of prospective and current faculty teachers. *Instr. Sci.* 51, 201–229. doi: 10.1007/s11251-022-09603-7
- Kelly, M., Moore, D. W., and Tuck, B. F. (1994). Reciprocal teaching in a regular primary school classroom. *J. Educ. Res.* 88, 53–61. doi: 10.1080/00220671.1994.9944834
- Kielstra, J., Molenaar, I., van Steensel, R., and Verhoeven, L. (2022). Supporting socially shared regulation during collaborative task-oriented reading. *Int. J. Comput.-Support. Collab. Learn.* 17, 65–105. doi: 10.1007/s11412-022-09365-x
- Kintsch, W. (1986). Learning from text. *Cogn. Instr.* 3, 87–108. doi: 10.1207/s1532690xci0302_1
- Kollar, I., Fischer, F., and Hesse, F. W. (2006). Collaboration scripts—a conceptual analysis. *Educ. Psychol. Rev.* 18, 159–185. doi: 10.1007/s10648-006-9007-2
- Livingston, C., Klopper, B., Cox, S., and Uys, C. (2015). The impact of an academic reading programme in the bachelor of education (intermediate and senior phase) degree. *Read. Write.* 6, 1–11. doi: 10.4102/rw.v6i1.66
- MacLellan, E. (1997). Reading to learn. *Stud. High. Educ.* 22, 277–288. doi: 10.1080/03075079712331380896
- Mañá, A., Vidal-Abarca, E., and Salmerón, L. (2017). Effect of delay on search decisions in a task-oriented reading environment. *Metacogn. Learn.* 12, 113–130. doi: 10.1007/s11409-016-9162-x
- McCarthy, K. S., Guerrero, T. A., Kent, K. M., Allen, L. K., McNamara, D. S., Chao, S.-F., et al. (2018). Comprehension in a scenario-based assessment: domain and topic-specific background knowledge. *Discourse Process.* 55, 510–524. doi: 10.1080/0163853X.2018.1460159
- Mihalca, L., and Mengelkamp, C. (2020). Effects of induced levels of prior knowledge on monitoring accuracy and performance when learning from self-regulated problem solving. *J. Educ. Psychol.* 112, 795–810. doi: 10.1037/edu0000389
- Ntereki, B. B., and Ramoroka, B. T. (2017). Reading competency of first-year undergraduate students at University of Botswana: a case study. *Read. Writ.* 8, 1–11. doi: 10.4102/rw.v8i1.123
- OECD (2023). PISA 2022. Results (volume I): Excellence and equity in education. Paris: OECD Publishing. doi: 10.1787/53f23881-en
- Okkinga, M., van Gelderen, A., Van Schooten, E., van Steensel, R., and Slegers, P. (2021). Implementation quality of principles of reciprocal teaching in whole-classroom settings: a two-year study with low-achieving adolescents. *Read. Psychol.* 42, 323–363. doi: 10.1080/02702711.2021.1887019
- Palincsar, A. S., and Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cogn. Instr.* 1, 117–175. doi: 10.1207/s1532690xci0102_1
- Palincsar, A. S., Brown, A. L., and Martin, S. M. (1987). Peer interaction in reading comprehension instruction. *Educ. Psychol.* 22, 231–253. doi: 10.1080/00461520.1987.9653051
- Papadopoulos, P. M., Demetriadis, S. N., and Weinberger, A. (2013). ‘Make it explicit’: Improving collaboration through increase of script coercion. *J. Comput. Assist. Learn.* 29, 383–398. doi: 10.1111/jcal.12014
- Prince, M. (2004). Does active learning work? A review of the research. *J. Eng. Educ.* 93, 223–231. doi: 10.1002/j.2168-9830.2004.tb00809.x
- Radkowsitch, A., Vogel, F., and Fischer, F. (2020). Good for learning, bad for motivation? A meta-analysis on the effects of computer-supported collaboration scripts. *Int. J. Comput.-Support. Collab. Learn.* 15, 5–47. doi: 10.1007/s11412-020-09316-4
- Rosenshine, B., and Meister, C. (1994). Reciprocal teaching: a review of the research. *Rev. Educ. Res.* 64, 479–530. doi: 10.3102/00346543064004479
- Rouet, J.-F. B. (2011). “Relevance processes in multiple document comprehension” in Text relevance and learning from text. eds. M. T. McCrudden, J. P. Magliano and G. Schraw (Charlotte, NC: IAP), 19–52.
- Rouet, J.-F., Britt, M. A., and Durik, A. M. (2017). RESOLV: readers' representation of reading contexts and tasks. *Educ. Psychol.* 52, 200–215. doi: 10.1080/00461520.2017.1329015
- Salmerón, L., Naumann, J., García, V., and Fajardo, I. (2017). Scanning and deep processing of information in hypertext: an eye tracking and cued retrospective think-aloud study. *J. Comput. Assist. Learn.* 33, 222–233. doi: 10.1111/jcal.12152
- Salmerón, L., Vidal-Abarca, E., Martínez, T., Mañá, A., Gil, L., and Naumann, J. (2015). Strategic decisions in task-oriented reading. *Span. J. Psychol.* 18:E102. doi: 10.1017/sjp.2015.101
- Schellens, T., Van Keer, H., De Wever, B., and Valcke, M. (2007). Scripting by assigning roles: Does it improve knowledge construction in asynchronous discussion groups? *International Journal of Computer-Supported Collaborative Learning*, 2:225–246. doi: 10.1007/s11412-007-9016-2

- Schoonenboom, J. (2008). The effect of a script and a structured interface in grounding discussions. *Int. J. Comput.-Support. Collab. Learn.* 3, 327–341. doi: 10.1007/s11412-008-9042-8
- Serrano, M. A., Vidal-Abarca, E., and Ferrer, A. (2018). Teaching self-regulation strategies via an intelligent tutoring system (TuiNLEcweb): effects for low-skilled comprehenders. *J. Comput. Assist. Learn.* 34, 515–525. doi: 10.1111/jcal.12256
- Serrano-Mendizábal, M., Villalón, R., Melero, Á., and Izquierdo-Magaldi, B. (2023). Effects of two computer-based interventions on reading comprehension: does strategy instruction matter? *Comput. Educ.* 104727. doi: 10.1016/j.compedu.2023.104727
- Spörer, N., Brunstein, J. C., and Kieschke, U. (2009). Improving students' reading comprehension skills: effects of strategy instruction and reciprocal teaching. *Learn. Instr.* 19, 272–286. doi: 10.1016/j.learninstruc.2008.05.003
- Stribos, J.-W., and Weinberger, A. (2010). Emerging and scripted roles in computer-supported collaborative learning. *Comput. Human Behav.* 26, 491–494. doi: 10.1016/j.chb.2009.08.006
- Taraban, R., Kerr, M., and Rynearson, K. (2004). Analytic and pragmatic factors in college students' metacognitive reading strategies. *Read. Psychol.* 25, 67–81. doi: 10.1080/02702710490435547
- Tawfik, A. A., Graesser, A., Gatewood, J., and Gishbaugher, J. (2020). Role of questions in inquiry-based instruction: towards a design taxonomy for question-asking and implications for design. *Educ. Technol. Res. Dev.* 68, 653–678. doi: 10.1007/s11423-020-09738-9
- Vidal-Abarca, E., Mana, A., and Gil, L. (2010). Individual differences for self-regulating task-oriented reading activities. *J. Educ. Psychol.* 102, 817–826. doi: 10.1037/a0020062
- Vidal-Abarca, E., Martínez, T., Salmerón, L., Cerdán, R., Gilabert, R., Gil, L., et al. (2011). Recording online processes in task-oriented reading with Read&Answer. *Behav. Res. Methods* 43, 179–192. doi: 10.3758/s13428-010-0032-1
- Vogel, F., Wecker, C., Kollar, I., and Fischer, F. (2017). Socio-cognitive scaffolding with computer-supported collaboration scripts: a meta-analysis. *Educ. Psychol. Rev.* 29, 477–511. doi: 10.1007/s10648-016-9361-7
- Wijekumar, K., Zhang, S., Joshi, R., and Peti-Stantic, A. (2021). Introduction to the special issue: textbook content and organization—why it matters to reading comprehension in elementary grades? *Technol. Knowl. Learn.* 26, 243–249. doi: 10.1007/s10758-021-09505-6
- Wong, W. H., and Chapman, E. (2023). Student satisfaction and interaction in higher education. *High. Educ.* 85, 957–978. doi: 10.1007/s10734-022-00874-0
- Yeari, M., van den Broek, P., and Oudega, M. (2015). Processing and memory of central versus peripheral information as a function of reading goals: evidence from eye-movements. *Read. Writ.* 28, 1071–1097. doi: 10.1007/s11145-015-9561-4