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Classroom observations: How do teachers teach learning strategies?

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The aim of this study was to find out which learning strategies teachers teach, either directly or indirectly, and how classroom observations are related to teachers' knowledge of learning strategies. Seven different learning strategies were used. The Learning Strategy Teaching Observation Instrument (LSTOI) was developed for this study. Forty-five video-based classroom observations were conducted. Teachers showed strong knowledge of learning strategies, but they did not directly teach about strategies in the classroom. In order to find out how teachers support learning strategies in the classroom, we conducted a detailed analysis of two teachers who provided the greatest amount of direct strategy instruction. Results showed that, although these teachers gave more direct strategy instruction than others, they justified the usefulness of strategies by saying that students will achieve better results in an upcoming test or examination. A better approach would be to explain the long-term impact of learning strategies and develop students' skills in independently applying strategies in the future.

KEYWORDS

classroom observation, learning strategies, direct strategy, indirect strategies, teacher knowledge

Introduction

The need to support the development of self-regulated learners starting from primary school is widely acknowledged (e.g., Schunk and Greene, 2018). A critical dimension of self-regulated learning is knowledge and adequate application of learning strategies (i.e., activities carried out during learning that directly affect the process and outcomes of learning; Fiorella and Mayer, 2015a; Dinsmore and Hattan, 2020; Van Meter and Campbell, 2020). Researchers differentiate between deep-level learning strategies (e.g., composing drawings) and surface-level learning strategies (e.g., rereading), emphasizing that deep-level strategies tend to support comprehension of new material such that learned knowledge can be later recalled and flexibly used for solving novel learning tasks (Fiorella and Mayer, 2015a; Hattie and Donoghue, 2016; Dinsmore and Hattan, 2020). It is important to learn which strategies support deep-level or surface-level learning and how this support varies depending on the learning situation and task (Frey et al., 2017; Dirkx et al., 2019). Knowing different learning strategies and adequately applying them in learning is important for students in order to independently learn new material, plan their studies, and establish objectives (Dignath and Veenman, 2020).

Since relatively high working-memory capacity and reasoning abilities are needed to appropriately use deep-level learning strategies, young children often use surface-level learning strategies instead (Schleepen and Jonkman, 2012; Seufert, 2020). Research across different countries has indicated that knowledge of deep-level learning strategies and the ability to apply them is poor, even among middle- and high-school students whose cognitive abilities are more developed (Bjork et al., 2013; Kikas et al., 2020). To understand the efficacy of complex, deep-level learning strategies, (1) students need to explicitly discuss the learning process and different learning strategies that support students' metacognitive knowledge, and (2) students need to have the opportunity to practice different learning strategies' application (Dignath et al., 2008; Clerc et al., 2014). Teachers play an important role in this process (Kramarski and Kohen, 2017). However, classroom observations have shown that teachers primarily give indirect rather than direct (i.e., explicit) instruction regarding learning processes and strategy use (Hamman et al., 2000; Dignath and Büttner, 2018). So far, classroom observations have only been used in a few countries and mainly in middle school (Hamman et al., 2000; Kistner et al., 2015; Zepeda et al., 2018). To better understand how teachers support students' knowledge of and skills in applying learning strategies, observation studies are needed in different countries and age groups. Moreover, no specific attention has been paid to which specific strategies teachers teach.

The main aim of this study was to develop and use an observation tool to examine how much time teachers dedicate to teaching different learning strategies, either directly or indirectly. Our secondary aim was to analyze links between classroom observations and teachers' knowledge of learning strategies to see how teachers' knowledge of learning processes and strategies manifests in classroom teaching. This study was carried out in Estonia, which, according to PISA (Program for International Student Assessment) results, ranks highly in Europe and among the best countries in the world in terms of ensuring the effectiveness and equality of basic education (Schleicher, 2019). Prior studies have shown that Estonian teachers have a high knowledge of current learning approaches, a good understanding of learning strategies, and strong skills in promoting individualized learning strategies (Uibu and Kikas, 2012; Tang et al., 2017; OECD, 2019). In contrast, student knowledge of learning strategies has been shown to be generally poor, even at the end of middle school (Kikas and Jõgi, 2016; Hennok et al., 2022). To better understand this gap, it is important to study how teachers teach different learning strategies in the classroom.

Learning strategies

We conceptualize learning strategies as goal-oriented activities for acquiring, organizing, and transforming new information (Weinstein et al., 2011; Dinsmore and Hattan, 2020). As mental or cognitive processes that a student carries out during learning, learning strategies are related to what is learned (i.e., memorized and understood; Alexander et al., 2018; Van Meter and Campbell, 2020). Learning strategies are generally divided into two groups: strategies that tend to support deep learning and strategies that tend to support surface learning (Frey et al., 2017; Weinstein et al., 2019). While surface learning generally results in the memorization of isolated facts that are not easily recalled and cannot be used flexibly later on, deep learning occurs when students are mentally engaged and construct new knowledge and thus involves the creation of memory content that can be recalled and flexibly applied long after learning takes place (Beattie et al., 1997; Chi, 2009; Carpenter et al., 2020; Dinsmore and Hattan, 2020).

When using strategies that facilitate deep learning, the learner must complete three cognitive processes: (1) *selecting* or reviewing the important material, (2) *organizing* or arranging incoming information into a coherent cognitive structure, and (3) *integrating* or linking cognitive structures and relevant information in long-term memory (Fiorella and Mayer, 2015b). Students learn more deeply if they can comprehend, organize, and restate the main ideas of the learned material. There are several ways to integrate new information; i.e., there are several different learning strategies that support deep learning. For instance, using visuals (visualizing) helps integrate information from verbal and visual channels (Rau et al., 2015; Roessger et al., 2018). Creating associations with existing knowledge, grouping, and summarizing learn-to-be material supports verbal integration of material (Bjork et al., 2013; Weinstein et al., 2019). Predicting outcomes before learning activates prior knowledge and improves further integration of information (Brod, 2020). Self-testing (e.g., answering questions) learned material consolidates what has been learned and helps integrate learned information in different ways (Adesope et al., 2017; Brod, 2020; Agarwal et al., 2021). Distributing learning over longer periods has a similar effect: learners repeatedly activate learn-to-be information and make new associations (Carpenter et al., 2012; Kang, 2016; Weinstein et al., 2018; Agarwal et al., 2021).

During surface learning, students perceive new information, tend to mechanically repeat and memorize it, but do not attempt to integrate the new information with what is already known (Dinsmore and Alexander, 2012; Hattie and Donoghue, 2016; Alexander et al., 2018). Three frequently used surface-level learning strategies include rereading, rehearsing, and checking learned material (Dunlosky et al., 2013). When combined with deep-level strategies (e.g., self-testing, searching for associations), these strategies can be made more effective (Chi and Wylie, 2014). Practicing new skills may be related to surface learning when students have to repeatedly solve similar problems, but it can lead to deep learning when students are given different, challenging problems (*cf.* Chi and Wylie, 2014).

In self-regulated learning, it is important to establish learning goals and analyze the whole learning process, both of which are important learning strategies that relate to superior metacognitive knowledge and skills (Veenman, 2017; Dignath and Büttner, 2018; Dinsmore and Hattan, 2020). The application of self-regulated learning and metacognitive knowledge and skills characterizes deep learning. Moreover, there is no single most-effective learning strategy or collection of strategies, as the usefulness of each strategy depends on a student's current knowledge and abilities as well as the specific learning task and learning context (Weinstein et al., 2011; Dinsmore and Alexander, 2012). All aforementioned learning strategies are described in more detail in Appendix A.

How to teach learning strategies

In order to help students become self-regulated learners who are capable of independently applying learning strategies adaptively according to a given task, teachers must explicitly teach about learning strategies and how to use them (Dignath and Büttner, 2018). It is important that students learn to reflect upon and analyze their own learning, and in order to develop metacognitive awareness, students need to be explicitly guided (Zepeda et al., 2018). Strategies can be taught either indirectly or directly.

During indirect strategy instruction, teachers model the application of a learning strategy–i.e., they use the learning strategy themselves, without explicitly referring to it, drawing attention to it, or providing explanations about its effectiveness (Dignath and Veenman, 2020). When teaching by modeling, students are expected to observe the application of a strategy and start using it later on by themselves. For instance, teachers may model visualization by showing drawings, models, or videos that support comprehension of the learned material. Moreover, teachers may ask students to use or even create visual materials like drawings, but teachers do not explicitly refer to these visual materials as methods that support learning (i.e., as learning strategies).

During direct (explicit) strategy instruction, a teacher demonstrates a strategy, specifically refers to the activity as a strategy, shows students how to apply it, and explains its usefulness. A teacher may also describe a strategy and explain why and how to use it but not demonstrate its application (Silver et al., 2007; Dignath and Veenman, 2020). Alternatively, a teacher may assign a task which requires the use of a strategy and provide instructions about how and why to use it (Veenman, 2011; Dignath and Büttner, 2018). For instance, when asking to draw a schema, teachers can explicitly state that schemas enable better comprehension of the learning material by integrating verbal knowledge with visual knowledge. In addition, teachers may refer to the practice of teaching and asking about learned material several times as a deep-level learning strategy (i.e., distributing) which enhances later recall and flexible use of learned knowledge. Teacher practices that are related to supporting specific learning strategies are given in Appendix A.

Both younger and older learners need support in learning about and applying learning strategies (Dignath and Büttner, 2018). Without direct instruction, learners do not get explicit knowledge about learning strategies, their strengths and weaknesses, or how and when to apply them (Brevik, 2019). Thus, indirect teaching does not enhance metacognitive knowledge of learning strategies, and as a result, students may not be able to use them independently and may revert to using simpler and less-effective strategies (Ewijk et al., 2013; Schuster et al., 2018). If students are encouraged to use a certain strategy and given clear information about the importance of that strategy, their performance should improve, and they should gain the ability to apply that strategy again when facing a similar problem.

Classroom observations and previous studies

Classroom observations are effective for assessing teachers' activities directly in their natural environment (Dignath and Veenman, 2020). Several studies have used observations to study teachers' support of self-regulated learning (Hamman et al., 2000; Kistner et al., 2010; Ewijk et al., 2013) as well as their support for cognitive, metacognitive, and self-regulation strategies (Dignath and Büttner, 2018; Zepeda et al., 2018; Brevik, 2019). In one of the earliest known studies, Moely et al. (1992) examined 69 primary school teachers' direct strategy instruction and the ways in which this varied according to subject and grade level. Results showed that teachers gave more instructions on using cognitive strategies in Grade 4 than in Grades 2 or 3. Moreover, teachers only provided rationales for how they used strategies in less than 2% of the observable time, and 10% of teachers gave no strategy suggestions at all.

Subsequent studies have confirmed that relatively few teachers give concrete and direct instructions on strategy use. For instance, Hamman et al. (2000) found that, among 11 middle school teachers and 235 students, only 2% of teachers recommended specific learning strategies in the classroom. The same study showed that student knowledge about learning strategies was directly related to the activities of teachers in the classroom. Kistner et al. (2015) confirmed that teachers typically taught cognitive strategies (elaboration, organization, problem solving) rather than metacognitive strategies (planning, monitoring). They also found great variability among teachers' instructions on strategy use and that elaboration was the strategy taught most often. In line with these findings, Zepeda et al. (2018) found that teachers only talk about strategies 7% of the time of each classroom lesson.

Results have been contradictory in the context of different subjects. Some studies have indicated that math teachers provide more instruction on strategy use than other subject teachers (Moely et al., 1992), but other studies have found no significant differences between subjects (Hamman et al., 2000). Student age is also important; older students can use complex learning strategies more effectively on their own than younger students (Brod, 2020), while younger learners need more direct instruction about how and when to use learning strategies (Schleepen and Jonkman, 2012).

It has also been found that observation results do not correspond with teachers' own opinions about how they teach strategy use in the classroom (Ewijk et al., 2013). Despite teachers having strong knowledge of learning strategies themselves (Halamish, 2018), this typically does not manifest into concrete classroom activities or direct instruction (Zepeda et al., 2018).

Aims and hypotheses

The main aim of this study was to observe how much time teachers dedicate to teaching different learning strategies, both directly and indirectly, and to analyze the relationship between teachers' knowledge of strategies' effectiveness and actual classroom teaching. The study was conducted in Estonia, where various studies show that students have good subject knowledge (OECD, 2019) and that teachers' knowledge of learning approaches is also good (Uibu and Kikas, 2012; Tang et al., 2017; OECD, 2019). However, little is known about how teachers teach different learning strategies in the classroom. Students in Grades 4 and 6 were chosen as target populations because, at this age, due to the development of working memory capacity and executive functions, students become capable of using strategies that support deep learning (Schleepen and Jonkman, 2012; Brod, 2020). Starting from Grade 4 in Estonia, the content of study material becomes more complex, learning requires more independent work, and, thus, good learning skills become more important. As complex strategy use presumes conceptual change around Grade 4, explicit teaching of strategies is especially important to overcome utilization deficiency (Clerc et al., 2014).

The following research questions and hypotheses were established:

First, how much time do teachers devote to teaching different learning strategies directly and indirectly according to classroom observations? We expected that (H1) teachers would rarely teach strategies indirectly and even less directly (Kistner et al., 2010; Ewijk et al., 2013; Dignath and Büttner, 2018).

Second, how do teachers justify the effectiveness of different learning strategies in certain learning situations? And how is teachers' knowledge of learning strategies (as expressed *via* justifications) related to their classroom practices? We expected that (H2a) teachers would mainly provide scientifically correct justifications for their preference toward different strategies (Granström et al., 2022), but that (H2b) the relationship between justifications and direct and indirect teaching practices would be low (Kistner et al., 2010; Dignath and Büttner, 2018). Prior studies have shown that, although teachers' knowledge of learning strategies tends to be good (Halamish, 2018), this knowledge often does not manifest in the form of concrete activities in the classroom (Zepeda et al., 2018).

Third, how do teachers' direct teaching of learning strategies manifest in classroom practices? Two teachers qualitatively described which direct instructions about strategy use they gave to students in the classroom. This analysis focused on the two teachers who, based on observations, gave the largest amount of direct instruction about strategy use.

Materials and methods

Participants

Participants included 15 teachers from five schools [13 women (86.7%) and two men (13.3%)]. The average age was 39.67 years (SD = 10.78, range 26–56). At the time of the study, nine teachers had completed university teacher education, while six were currently undergoing initial teacher education while actively working at a school. Five teachers taught in Grade 4, and 10 teachers taught in Grade 6. Five teachers taught Estonian language, three history, two biology, two English, two math, and one Russian language (see Appendix B).

Procedure

The study took place from September–October 2021. First, partner schools of the Tallinn University were invited to participate. Letters describing the study's aims and procedures were sent to schools, and the participants of educational program "Teach for Estonia" were introduced to the present study in a meeting. Five schools and 15 teachers from Grades 4 and 6 agreed to participate. Participation was voluntary. Participating teachers were introduced to the general objectives of the study and the methods for observation. Parents were informed about the study and the fact that the classrooms would be recorded. If a parent did not agree to have their child filmed, they were given the opportunity skip class that day.

Before observation, teachers filled out a questionnaire pertaining to different learning strategies (Appendix C). It took somewhere between 15 and 20 min. The questionnaire was conducted in a Qualtrics environment.

We used a video-based observation method, which means that the observed lessons were recorded, and the results were later viewed and coded. Iris Connect software was used for recording *via* tablet computer. This program makes it possible to save classroom recordings without breaking any privacy laws. Recording were only available to the members of the research group. The researchers installed tablets in all classrooms for the purposes of recording. All participating teachers were trained on how to independently use the application and how to record classes without disruptions. Teachers independently recorded three consecutive lessons of the same subject and class.

We used a 3-min interval method to register which strategies were used and on which level (Ewijk et al., 2013). In order to record the observation results, a 33 (strategies) x 45 (15 intervals with 3 subcategories for 45-min lessons; or 25 for 75-min lessons) table was created. In total, 45 lessons were recorded, 29 of which were 45 min long and 16 of which were 75 min long. We transformed all 75-min lessons into 45-min lessons (score/75 × 45) (Dignath and Büttner, 2018), which is the length of a typical classroom lesson at the majority of Estonian schools.

Measures

Learning strategy teaching observation instrument

Developing the observation protocol. The development of the Learning Strategy Teaching Observation Instrument (LSTOI) started with discussions among a group of teachers and university researchers. First, based on literature (Dunlosky et al., 2013; Fiorella and Mayer, 2015b; Weinstein et al., 2018), several different versions of the observation instruments were developed and discussed. The most prominent learning strategies highlighted by previous research were chosen to be the focus of this observation instrument. The observation instrument of the pilot study was comprised of seven categories of learning strategies: (1) using visual materials to create associations during learning (pictures, drawings, models, etc.); (2) creating associations between everyday life and previously learned material; (3) using grouping/categorizing material while learning; (4) summarizing/rereading/reviewing the materials (practicing); (5) testing; (6) explaining the study material to others; and (7) other. For each category of general learning strategy, direct and indirect teaching practices were differentiated (Dignath and Veenman, 2020).

Pilot study. The LSTOI was validated using four different observations which took place during third-grade mathematics and Estonian language lessons. During each observation, two observers observed the same lesson, and later, those conducting the study compared the results of the two observers and made changes to the observation protocol. One of the observers was the researcher who developed the instrument and the first author of the paper; the second observer was a practicing teacher with no connection to the current research. No additional instructions were given to the second observer at any point. This allowed us to gauge how easy it would be to understand the learning strategies included in the observation report. In order to reduce ambiguity and improve intelligibility of the observation instrument, the differences between the results of these two observers were compared, then the second observer (the teacher) was asked how they understood the categories in the observation instrument. Based on their feedback, the researchers made changes to the observation instrument.

The observers checked the coincidence of observing different teaching strategies. An interrater reliability analysis using the Kappa statistic was performed to determine consistency among raters. During the first observation, coincidence was $k = 0.053$ ($p > 0.05$), which means that the reliability between the two observers was very poor (Cohen, 1988), and, statistically speaking, these results were not reliable. Valid cases in Table 1 indicate the maximum number of notes the observers made during the observation protocol (i.e., number of learning strategies observed). Using this, it was possible to calculate the percentage of the results of the two observers coincided. Before each subsequent observation, the observation protocol was updated. By the fourth observation, after the observation protocol had been updated three times, interrater reliability between the two observers became acceptable ($k = 0.754$, $p < 0.05$).

Main study

The pilot study clearly indicated the need to change the categories of the observation instrument (i.e., seven general categories eventually became 12 categories). The final LSTOI assessed teaching of 12 general learning categories: (1) visualizing; (2) creating verbal associations; (3) grouping; (4) summarizing; (5) predicting; (6) testing/self-testing; (7) distributing; (8) rereading the material; (9) reviewing study material; (10) practicing new skills; (11) establishing learning goals; and (12) self-analysis. A detailed descriptions of learning strategies and teaching practices are given in Appendix A.

Teaching levels

Teaching about learning strategies was evaluated on two levels: (1) indirect instruction (i.e., the teacher does not discuss learning strategies directly, but uses strategies either alone or together with students); and (2) direct instruction (i.e., the teacher explains how and why a learning strategy could be used; the teacher discusses the use and necessity of a teaching strategy with students) (Dignath and Büttner, 2018).

Questionnaire of different learning strategies

The questionnaire asked teachers to evaluate the efficacy of different learning strategies in seven learning scenarios and to justify their answers (McCabe, 2011; Granström et al., 2022). Each learning scenario described a learning task that was solved by two students: one using a deep-level learning strategy, and another using a surface-level learning strategy (see Appendix C). Teachers had to justify their answers using their own words (the prompt was: "Please justify your choice"). Justifications were coded into two categories. First, scientifically correct justifications were responses based on theoretical knowledge related to the psychology of learning (McCabe, 2011; Granström et al., 2022). Teachers mostly justified their answers in two ways: (1) why one strategy is more effective (e.g., distributing learning material supports long-term learning and is therefore more effective than massing), and (2) why another strategy is less effective (e.g., reading by itself, without asking any additional questions, does not provide a deeper understanding of the content of the sentences, but instead only provides a general impression of the topic). Second, scientifically incorrect justifications included: (1) misconceptions (e.g., there are visual and verbal learners); (2) general and descriptive answers which failed to justify the advantages of one strategy over another (e.g., it is easier to learn from pictures); and (3) no justification. Scientifically correct justifications were responses based on theoretical knowledge that related to the psychology of learning (McCabe, 2011; Granström et al., 2022).

TABLE 1 Preliminary observations for validating the observation instrument.

	%	k	*p*	Valid cases
1st Observation	15.40	0.05	0.52	13
2nd Observation	30	0.09	0.57	10
3rd Observation	55	0.51	0.01	8
4th Observation	83.30	0.75	0.01	16

% = Percentage of coincidence of the two observers; k = Cohen's kappa.

Data analysis

To answer the first research question, observation data were coded by two observers, both of whom had a background in teacher education. The first observer was the first author of this study, and the second observer had been previously given a five-hour instruction course. Interrater reliability between the two coders was good, overall Kappa = 0.839 ($p < 0.001$), 95% CI (0.794, 0.885). Both observers encoded 45 lessons. Kappa for direct strategy instruction was 0.836 ($p < 0.001$), 95% CI (0.788, 0.883), and Kappa for indirect strategy instruction was 0.844 ($p < 0.001$), 95% CI (0.799, 0.890).

The observers coded teacher approaches into two different categories: (1) indirect instruction, and (2) direct instruction (Dignath and Büttner, 2018). Every 3 min, the observer stopped the videotape and marked all strategies a teacher taught during the previous three-minute interval, either indirectly or directly.

Descriptive statistics were used to provide information on how many different strategies teachers indirectly or directly taught in the classroom as well as how many direct and indirect strategy instructions were given in total. Observation results were analyzed separately for each individual teacher and for the aggregate total.

To answer the second research question, questionnaire results were coded by two coders. One coder was one of the authors of this article, and the other coder was an educational researcher. Interrater reliability between the two coders was very high, Kappa = 0.925 ($p < 0.001$), 95% CI (0.822, 1.027). The sum of scientifically correct justifications was used. Spearman's correlation and Mann–Whitney U-test were performed to compare observational and questionnaire data.

To answer the third research question, a separate observation and results analysis was carried out using the two teachers who gave the greatest amount of direct strategy instructions. The two teachers' direct instructions regarding strategy use were transcribed.

Results

Direct and indirect teaching of learning strategies in the classroom

Descriptive statistics for direct and indirect teaching practices are shown in Appendix A, and descriptive statistics for supporting 12 learning strategies are shown in Table 2. Scores show how many times within three lessons teachers either directly or indirectly taught specific learning strategies. Teachers used indirect teaching more (834.2 times) than direct teaching (32.60 times). The most frequently used direct instructions supported reviewing previously learned

TABLE 2 Descriptive statistics of direct and indirect instruction of learning strategies.

Learning strategy	Teacher practices: direct instruction					Teacher practices: indirect instruction				
	Min	Max	Sum	Mean	SD	Min	Max	Sum	Mean	SD
1. Visualizing	0	1	1.60	0.11	0.29	0	23	118.60	7.90	7.30
2. Creating verbal associations	0	1	1	0.07	0.26	0	17	114.20	7.61	5.26
3. Grouping	0	1	1.60	0.11	0.29	0	10	52.80	3.52	3.60
4. Summarizing	0	0.60	0.60	0.04	0.15	0	6.60	30.20	2.01	1.99
5. Predicting:	0	.	.	.	.	0	1	1	0.20	0.149
6. Testing/self-testing	0	1	2.20	0.15	0.32	0	12	85.80	5.72	3.68
7. Distributing	0	1	1	0.20	0.149	0	1	1	0.20	0.149
8. Rereading the material	0	.	.	.	.	0	13	67.80	4.52	4.30
9. Reviewing study material	0	6	12.40	0.96	1.92	2.40	17	134.40	9.22	3.62
10. Practicing new skills:	0	2.40	6	0.40	0.69	7	24	211.80	14.12	4.73
11. Establishing learning goals	0	1	1	0.20	0.149	0	3	10.80	0.29	0.58
12. Self-analysis	0	2	5.20	0.11	0.33	0	2	5.80	0.12	0.35
Total	0	1.73	32.60	0.23	0.053	0.94	12.80	834.20	4.65	3.63

The maximum possible score was 45. Scores for 75-min classes were transformed into scores for 45-min lessons (score/75 min x 45 min). Decimal places are a result of converting 75-min lessons into 45-min lessons. Sum show how many times within three lessons teachers either directly or indirectly taught specific learning strategies.

material and encouraging self-analysis. The most frequently used indirect instructions supported practicing new material and reviewing. These two strategies were also taught by all teachers, albeit only indirectly. Strategies related to visualization and creating associations stood also out in indirect strategy instruction.

Teachers differed in the amount of total direct and indirect instruction provided (see Figure 1). Teachers 1 and 2 applied the most direct strategy instruction (eight and seven times, respectively) while using indirect instruction less than other teachers. Seven teachers did not give any direct strategy instruction during any of the three lessons.

Justifications of the efficacy of learning strategies and their relations with observed instruction

Teachers had to evaluate the efficacy of two learning strategies across seven scenarios and justify their answers. Teachers' knowledge according to justifications was good (see Appendix B). Appendix B shows the amount of direct and indirect instruction provided by each teacher across the three observed lessons and how many scientifically correct justifications they gave for the scenarios. Seven teachers out of 15 provided scientifically correct justifications for all scenarios. One teacher provided two scientifically correct justifications, and one teacher provided three.

To examine if teachers with better knowledge of learning strategies teach strategies more frequently than those with poorer knowledge, we first calculated Spearman's correlation, $r = -0.098$, $p = 0.728$. In addition, we created two groups: (1) teachers who gave correct justifications to all scenarios, and (2) teachers who gave fewer correct justifications. The Mann–Whitney U test indicated a non-significant difference between the two groups in indirect instruction, $U = 26.48$, $p = 0.916$, and direct instruction, $U = 23.00$, $p = 0.701$. According to both methods, no statistically significant relations were found between observed practices and knowledge.

Manifested instruction of learning strategies in the classroom—examples of two teachers

For detailed descriptive analysis, we studied the two teachers who gave the most direct instruction about the use of strategies (Figure 1). Teacher 1 taught mathematics in Grade 6, and Teacher 2 taught Estonian language in Grade 4.

Teacher 1

Teacher 1 was 56 years old, male, held a master's degree, and had worked as a mathematics, physics, and chemistry teacher for over 30 years. He provided the greatest amount of direct instruction regarding the use of learning strategies (eight occasions in four different categories). This teacher also gave scientifically correct justifications for all scenarios (see Appendix C).

His direct instruction mostly focused on reviewing earlier learned material. He recommended this strategy by explaining that it improves study results and that study material is retained for a longer period. While he did not provide instruction on how to review earlier learned material independently, he still explicitly referred to the positive aspects of this strategy. He also explained to the students:

> *It is important for us to constantly review what we have learned before, as reviewing helps us to better remember what we have learned before. Therefore, we will start this lesson with review and will go over the topics we did not learn together due to the coronavirus.*

For the same strategy, he also provided the following justification, encouraging students to review study material at home:

> *I now ask you to independently practice solving operations with fractions — we will recall and review. Does anyone know why reviewing is important? It is important because then you'll*

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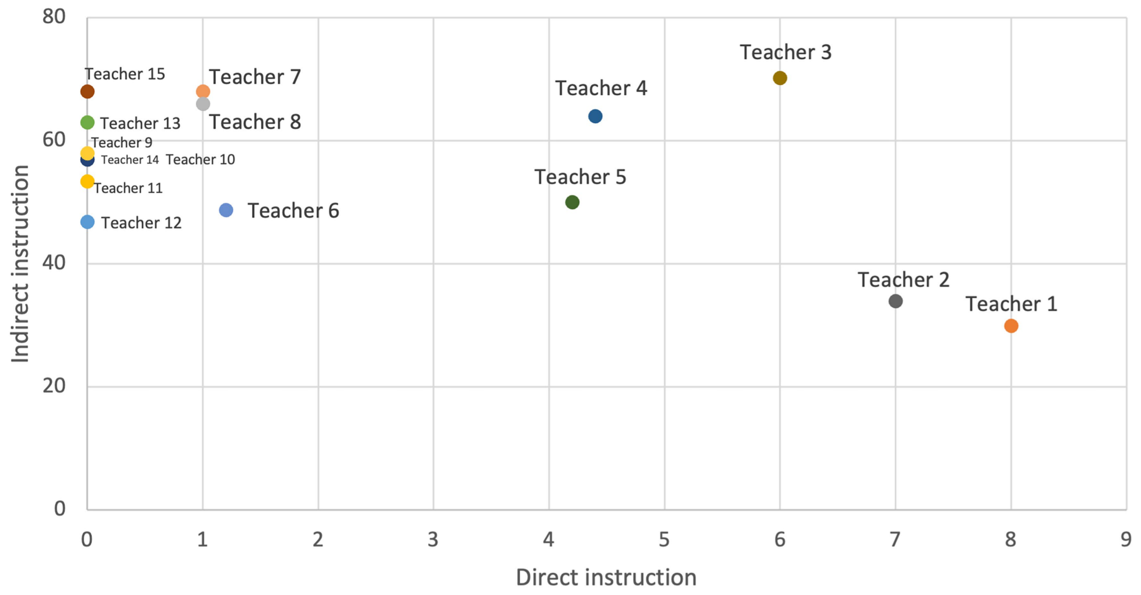

FIGURE 1
Direct and indirect strategy instruction by teacher.

> *remember more, and I strongly recommend that you independently review at home [...] we are doing that together here, but you also have to do it at home.*

Teacher 1 also provided direct strategy instruction regarding reviewing earlier learned material. The teacher explained that new knowledge is related to previous knowledge and, therefore, previously learned material should be reviewed. He asked the students questions about why it would be good to use this strategy, but he did not let students answer themselves. The teacher gave the following explanation in the classroom:

> *The principle in tests is that 15–20% of problems are taken from what was learned in the previous period. What is the point of that? The point is to anchor and repeat previous knowledge, as learning mathematics is a compound process [...] and constantly recalling the topics we have previously studied helps us associate new knowledge with the topics we have previously covered.*

Teacher 1 also gave direct strategy instruction regarding testing/self-testing. Here, the teacher provided specific directions about how to independently apply this strategy and explained why independent self-testing is useful:

> *You have a good opportunity to test your knowledge at home before the test. Testing your own knowledge is good for several reasons: first, you'll find out what you don't know and then you'll remember it better. I recommend that you don't look at the answers at the end of the textbook — rather, solve the problem first, and then check if you got the right answer.*

On the other hand, Teacher 1 modeled testing as a learning strategy, but did not refer to its usefulness for learning (i.e., indirect instruction):

> *Next, we will solve the tasks—solve the tasks from the workbook, Tasks 2–4. The correct solutions are in the back of the workbook. You can check them later.*

Direct instruction was also provided for the category practicing new material, specifically highlighting distributing. The teacher explained and provided instruction on how to use this strategy and why it is an effective way of learning:

> *Try and solve these problems on your own, but don't do it right after the lesson when you'll remember it all and perhaps feel like you can solve them easily. Instead, do it, say, a few hours later or in the evening or the next day, and then you'll see whether you can actually solve them […] This is a good way to find out whether you mastered the task or not. When you try to solve it later, you'll remember it better, and you'll still remember it during the test.*

Teacher 2

Teacher 2 was 43 years old, female, had worked for over 20 years as a teacher, and was enrolled in a teacher education program at a local university. She taught several subjects in Grades 4 and 6: Estonian language, mathematics, nature, civic studies, and art. This study focused on her Estonian classes. Teacher 2 provided direct instruction on the use of learning strategies on seven occasions and gave four (out of a maximum of seven) scientifically correct justifications (see Appendix C).

Two of Teacher 2's direct instructions were related to reviewing earlier learned material. Teacher 2 also provided students with instructions on how to apply this strategy and justified why it is necessary:

> *We will review the tasks together, then anyone can ask if something remains unclear. I will review with you, as this way we can better*

> *anchor the material, and everything will be clear by the time of the test. You can also review in the same way with your classmates or with your mother or father at home. Reviewing helps you memorize things better and it is good for independent use.*

Teacher 2 also explained why the reviewing of material is useful and how it helps to better anchor the study material:

> *A good trick is to first review the entire task sheet and then choose the tasks that seem less familiar and try to solve those. We could then review the more complex ones with your classmates. This is a good trick for anchoring and reviewing the study material. Then all the tasks on the task sheet are familiar to you.*

Teacher 2 also gave direct instruction regarding visualizing and explained how students can better memorize study material with the help of visual materials:

> *I have a question for you: How do you learn? Did you look at pictures? Pictures are a very good method for remembering poems. We'll try it together and see whether it makes learning easier. I'll distribute one tablet for every two students, and I'd ask you to find three or four pictures that best describe the poem.*

In contrast, Teacher 1 only referred to pictures but did not talk why they are helpful for the learning process (i.e., indirect instruction):

> *Let's take the textbook, page 46, and now we will all read together. Let's all read together and then we will discuss, and maybe I will show you the pictures too.*

Discussion

This study examined how much time teachers spend on indirect and direct teaching of different kinds of learning strategies. In line with previous studies, we found that teachers rarely teach knowledge and application of learning strategies directly. We expanded on previous research by finding that teachers most commonly provide direct instruction regarding reviewing learned material, and mostly commonly provide indirect instruction regarding practicing material. Participating teachers were mostly able to justify the advantages and disadvantages of different learning strategies for concrete learning tasks in a scientifically correct manner, but this knowledge did not manifest in observed classroom practices. Examples from the two teachers who most frequently provide direct instruction of learning strategies were used to illustrate possible teaching practices.

Direct and indirect teaching of learning strategies in the classroom

As expected, (H1) and in line with earlier studies (Kistner et al., 2010; Ewijk et al., 2013; Dignath and Büttner, 2018), teachers tended to use indirect rather than direct instruction about strategy use. We found a very low proportion of direct strategy instruction compared with indirect instruction, which aligns with previous classroom observations (Kistner et al., 2015; Zepeda et al., 2018). Although the Estonian national curriculum states that students' learning to learn skills, including knowledge of learning strategies, should be supported throughout primary and middle school (Estonian Government, 2021), this study demonstrates low support in actual classroom lessons. Although some teachers provided direct instruction, such instruction was quite limited. Moreover, six teachers out of 15 did not give any direct instruction regarding strategy use during three classroom lessons.

As we did not examine students, we can only speculate how such limited teaching of learning strategies may relate to students' knowledge of and skills in using different learning strategies. Still, it may be one reason why Estonian students have shown low knowledge of learning strategies, even at the end of middle school (Kikas and Jõgi, 2016; Hennok et al., 2022). Studies that have examined both teachers and students show that teachers' classroom activities directly affect students' knowledge about learning strategies (Hamman et al., 2000; Kistner et al., 2015). It should be mentioned that we specifically chose students who had the prerequisites for using more complex strategies (Brod, 2020) and were old enough to be capable of using strategies that support deep learning (Schleepen and Jonkman, 2012). Explicit teaching of different learning strategies—both previously used surface-level strategies and new deep-level strategies—is specifically needed at this age (Dignath and Veenman, 2020).

Teachers most often taught learning strategies around reviewing earlier learned material. This was the most frequent direct and second-most frequent indirect strategy taught after practicing new material. On the one hand, it is understandable that teachers ask students to review material and give review tasks as homework while explaining why this strategy is useful. On the other hand, it is notable that very few direct instructions on using more complex strategies were given, despite consistent findings that direct strategy instruction is very important in supporting the development of students' learning-strategy related knowledge and skills (Dignath and Büttner, 2018).

The finding that most indirect instruction was given around practicing new material and reviewing earlier learned material is understandable as these are everyday teaching practices and important parts of classroom lessons. Our observations did not look into specific practices qualitatively, such as specific teacher questions or problems students had to solve. Some questions (e.g., why, how) support deep learning while others (e.g., factual questions) only support surface learning (Weinstein et al., 2019). In addition, tasks for practicing new material may differ in terms of difficulty and similarity. Thus, we cannot draw conclusions about what kind of learning these practices supported. However, we found that only a few teachers ever discussed why reviewing and practicing are valuable for learning.

There are two primary ways of teaching learning strategies: either the teacher actively involves the students (e.g., through discussion) or they demonstrate use of the strategy without discussion or explanation. In the second case, the teacher is active and the students remain passive. To learn best, it is important that students are active in the learning process (Fiorella and Mayer, 2015a). In our observations, reviewing earlier learned material manifested in the material being repeated together with the teacher, instead of the teacher letting the students do it themselves (Appendix A).

The learning strategies creating verbal associations and visualizing were also taught indirectly. These are effective strategies that are difficult to learn without adult support (Rau et al., 2015; Weinstein et al., 2019), but we found that demonstrations of these strategies were not followed by an explanation from the teacher on how to use them. There was less indirect guidance (and rarely direct guidance) for strategies that support deep learning, such as grouping, testing/self-testing, and summarizing. Prior studies have found that, while 72% of students report self-testing as a learning strategy (Morehead et al., 2016), some students need additional teacher support. We can conclude that more complex learning strategies are given less direct instruction and are taught less in the classroom compared with strategies that are easier to use (Table 2). We may further speculate that teachers often fail to acknowledge the vital role of direct strategy instruction in supporting the development of self-regulated learners (Veenman, 2017) and academic success (Hamman et al., 2000).

Justifications of the effectiveness of learning strategies and their relations with observed instruction

Similar to previous findings in Estonia (Granström et al., 2022) and as expected, (H_2a), teachers mostly justified the effectiveness of learning strategies correctly. Nearly half of teachers provided scientifically correct justifications for all scenarios. However, even after analyzing using two statistical methods (Spearman's correlation and Mann–Whitney *U* test), teachers' knowledge of learning strategies was not related to their classroom practices. This confirmed our hypothesis (H_2b) and is consistent with previous findings (Kistner et al., 2010; Zepeda et al., 2018). This study indicates that teachers' knowledge of learning and learning strategies may not be transferred to their classroom practices, and this result is consistent with previous studies (Hamman et al., 2000; Schuster et al., 2018). In our study, we focused on teachers' knowledge of why particular learning strategies are more or less effective, but not on the teachers' understanding of how and when to support students' use of learning strategies.

The gap between teachers' strong theoretical knowledge of learning strategies and the amount of time devoted to teaching learning strategies may indicate that teachers consider indirect strategy instruction to be sufficient. Thus, further studies are needed to examine teacher beliefs and knowledge of supporting students' learning skills. In relation to teachers' beliefs about students' cognitive development with regard to growth mindsets, one prior study indicated that newly qualified teachers have a positive attitude toward student development and are able to enhance students' potential (Aus et al., 2016). The finding also refers to the need to improve teachers' skills in applying theoretical knowledge to classroom practices. Specifically, teachers who prefer teacher-directed or authoritarian-inconsistent teaching methods (as opposed to child-centered methods) may require—in addition to academic knowledge and skills—greater understanding about how to enhance students' learning competence (Uibu and Kikas, 2012; Tang et al., 2017).

Teaching learning strategies in the classroom

Based on our observations, we identified the two teachers who gave the highest ratio of direct to indirect instruction regarding strategy use. Previous research has aimed to uncover how much direct strategy instruction could be considered sufficient (Hamman et al., 2000; Kistner et al., 2015). Although there is no single and concrete answer, it has been found that teachers should consistently develop students' knowledge about different strategies. For instance, Hamman et al. (2000) found that direct strategy instruction requires about 10% of each classroom lesson. The two teachers in our study consistently provided instructions on the use of strategies. This, in turn, increases the possibility that students learn to independently use effective learning strategies and will progress to using more complex strategies later on. Teacher 1 provided different direct strategy instructions in a total of four different categories (distributing, creating verbal associations, testing/self-testing, and practicing the new material). This shows that the teacher's knowledge of different strategies is rather broad and that he is capable of justifying the value of these learning strategies to students. Teacher 1 also provided scientifically correct justifications for all scenarios in the questionnaire, which confirmed that strong knowledge of strategies was transferred into specific activities in the classroom.

Earlier studies have suggested that teaching strategies should be subject specific, since different subjects may benefit from different strategies (Schuster et al., 2018). Teacher 1 was a mathematics teacher. Math is often difficult for students because learning new material presumes strong mastery of previous material. In addition to teaching the study material, Teacher 1 focused on teaching students how to learn (Hamman et al., 2000). Teacher 2 was a language teacher, and she explained that language learning requires an understanding of the text, and visualization is a good strategic for this purpose (Rau et al., 2015). Teacher 2 provided different direct strategy instruction in two different categories: reviewing earlier learned material and visualizing.

Young learners need more instruction on learning strategies, and the strategies taught should progressively move from simpler strategies to more complex ones (Brod, 2020). In later grades, requirements for learning increase, and students have to increasingly plan their own learning activities, which also presumes better skills in using different strategies. In this study, Teacher 2 was a Grade 4 teacher who gave somewhat less direct instruction than Teacher 1, who was a Grade 6 teacher. It cannot be concluded from our study whether younger students receive more or less direct instruction than older students. But our results do show that Grade 6 teachers are better able to scientifically justify the use of different strategies, as six Grade 6 teachers justified all learning strategies in a scientifically correct way.

One shortcoming of both Teacher 1 and Teacher 2 is that, although they asked students why particular strategies should be used, they did not discuss the answer with students; rather, they answered the question themselves and justified the usefulness of the strategy by describing the potential for better results in a test or examination. A better approach would be to show students the long-term benefits of a particular strategy and discuss the usefulness of said strategy, which extends far beyond test performance. We know from previous studies that students tend to use strategies that facilitate surface learning (Kuhbandner and Emmerdinger, 2019), and if their teachers are also pushing for strong test performance, students may not be motivated to better develop their learning skills and establish more long-term goals (Hattie and Donoghue, 2016). Moreover, using deep-level learning strategies demands higher effort and relatively strong cognitive abilities

(Schleepen and Jonkman, 2012; Seufert, 2020). This means that students have to be motivated to use these strategies over easier-to-use surface-level learning strategies (Karabenick et al., 2021; Vu et al., 2022). Creating opportunities for students to think about and discuss the challenges, cost, and usefulness of deep-level learning strategies is a good way to boost students' motivation to use these strategies (Rosenzweig et al., 2019; Karabenick et al., 2021).

Our results show that teachers' justifications for learning strategies indicate strong knowledge of learning strategies and the learning process; however, teachers do not always use this knowledge during teaching. Previous research has shown that, in the absence of direct teaching and when strategies are not practiced in the classroom, learners tend to choose ineffective strategies that are not conducive to deep-level long-term learning (Dunlosky et al., 2013; Dirkx et al., 2019). If teachers clearly explain and help students practice various learning strategies, students are more likely to choose the appropriate strategies during a given learning task. However, this requires a systematic approach to the teaching of learning strategies (Kistner et al., 2010, 2015; Dignath and Veenman, 2020).

In summary, if teachers provide direct instruction on strategy use, correctly justify strategies, and help students practice strategy use, then students are likely to understand how to independently apply learning strategies in different learning situations. It is possible for teachers to link strategy instruction to specific learning tasks, and when new topics are studied, it is possible to learn a new strategy at the same time. Teachers can also give instructions on how to study independently at home and how to apply learning strategies while doing homework.

Conclusions, limitations, and future directions

Classroom observations showed that teachers rarely taught learning strategies directly, and the amount of time teachers devoted to teaching different learning strategies was not related to teachers' theoretical knowledge. We found that, while teachers may know the benefits of various strategies, they did not directly support students' knowledge of these strategies. Teachers more commonly used indirect strategies, which may indicate a belief that simply using a certain strategy is sufficient for the effective development of strategy-related knowledge in students. In reality, the development of learning strategies requires direct instruction and subsequent explanation about how to use them (Kistner et al., 2015; Dignath and Büttner, 2018).

Although teachers' knowledge of learning strategies is good (Granström et al., 2022), this knowledge is not actualized in the classroom. This means that students are unlikely to acquire full understanding of how and when to apply specific learning strategies. Teachers in this study seem to believe that simply using a strategy without additional explanations is sufficient, as there was rather little direct teaching about learning strategies. This is surprising given teacher's strong knowledge of learning strategies.

Future teacher trainings should pay more attention to the approaches teachers use in supporting students' knowledge and skills of learning strategies. Specifically, more time should be devoted to complex strategies that support deep learning. In order to do this, teachers must have strong practical skills in addition to good theoretical knowledge of strategies. Teacher training should primarily emphasize the practical skills of developing the students' knowledge of learning strategies. In addition, supporting materials for in-service teachers are needed to help actualize their strong knowledge of learning strategies in the classroom. For example, it would be worthwhile to develop specific observation guides aimed at raising awareness of one's own practice and evaluating the provision of direct and indirect learning strategy instructions in the classroom.

The current study had some limitations that must be addressed. First, the sample was quite small, which limits the ability to generalize our findings. In addition, learners of different ages and classes were observed, which can affect the direct and indirect teaching of learning strategies. Although we observed three consecutive classes of every teacher with the same group of students, we cannot definitively claim how much indirect or direct instruction teachers are regularly providing in the classroom. We asked teachers to avoid testing during the observations, which would have affected the results, and teachers agreed. We also wanted to engage more teachers from younger grades, but as classroom observations require thorough agreement with parents, and teachers tend to dislike their classes being recorded, we were unable to convince them to participate in the study. It should also be mentioned that the pilot observation was carried out by the same teacher (together with a researcher). Although the pilot observations took place over a relatively long period (2 months), this type of coding may have influenced the outcome of the pilot observation and, therefore, the validity of the observation instrument.

In the future, classroom observations should be extended to a broader sample. Future studies should also investigate how teachers support students of different ages, grades, and subjects in studying learning strategies. Finally, it is important to study how teachers' teaching of learning strategies is related to students' knowledge of learning strategies and their learning outcomes.

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 was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

Author contributions

MG planning the entire research process, data collection, setting research aims, questions and hypotheses, writing theoretical background, methodology writing, data analysis, formulation of results, and writing discussion and conclusions. EK writing theoretical background, data analysis, formulation of results, and consultation of results and conclusions. EE formulation of results and consultation of results and conclusions. All authors contributed to the article and approved the submitted version.

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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.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2023.1119519/full#supplementary-material

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