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Student self-regulated learning in teacher professional vision: Results from combining student self-reports, teacher ratings, and mobile eye tracking in the high school classroom

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Abstract

Teacher professional vision as a concept is gaining importance in research on teaching, and recently models for studying teacher professional vision and student self-regulated learning (SRL) have been proposed. There are interview and video intervention studies investigating teacher professional vision for SRL, but no real-life classroom research so far. This study investigated the role of student SRL behaviour, as it was reported by students themselves and teachers, in teacher attention distribution as part of teacher professional vision. Ten teachers and their 158 students at high school level in Lithuania took part in the research. The first step of the study resulted in identifying four student SRL-profiles, which differed based on student level of SRL and the extent to which teacher and student assessments coincided: mixed lower-regulated, mixed higher-regulated, systematic lower-regulated, systematic higher-regulated. The profiles demonstrated only a partial overlap in teacher and student judgement of student SRL. The second step of the study explored whether scores of students' SRL from student and teacher reports were related to teachers' distribution of visual attention in one lesson. The results showed that only one teacher rating scale of student information-seeking behaviour had a slight correlation with teacher attention. The results imply rather bottom-up trends in teacher attention to students in the classroom when it comes to SRL. Besides, the study results highlight the not directly observable nature of SRL processes and imply a difficulty for teachers to assess student SRL.

Keywords: self-regulated learning; self-report; teacher rating; cluster analysis; mobile eye tracking

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1. Introduction

Self-regulated learning (SRL) has been associated with higher student motivation and academic achievement (Zimmerman, 2001; Zimmerman & Kitsantas, 2007; Theobald, 2021) and is part of the European lifelong learning framework (Sala et al., 2020). Teachers can incorporate promotion of SRL in their classroom instruction by teaching the learning strategies to students or structuring the learning environment in an autonomy-supportive way (Dignath & Veenman, 2020). At the same time, students differ in their experience with and practice of SRL (Cleary et al., 2021; Heirweg et al., 2019). Thus, in order to provide support adequately, teachers need to be aware of students' SRL (Dignath & Sprenger, 2020). However, it is unclear to what extent teachers consider SRL-related factors when giving guidance and feedback to students directly in the classroom.

In the classroom, teachers do not formally assess students' SRL skills but rely on the cues from students by paying attention to students in the classroom. Teacher attention in the classroom can be explained through the concept of professional vision that comprises teacher's ability to dynamically notice and interpret classroom events that are relevant for student learning (van Es & Sherin, 2002; Seidel & Stürmer, 2014). Recently, models of professional vision specifically for teaching and assessing SRL have been proposed (Michalsky, 2014; Greene, 2021). Teachers need to recognise students' eventual needs for support and provide support accordingly (van de Pol et al., 2010). Understanding the variations in students' current levels of SRL is important, as teachers' SRL-related instructions that do not align with students' needs can be counterproductive (Vermunt & Verloop, 1999). In this sense, teachers need to employ both their SRL knowledge to assess their students' SRL involvement long-term and noticing skills to assess students' current support needs in each lesson. This makes it relevant to consider the interplay between the top-down and bottom-up noticing trends within teacher professional vision.

Previous observational studies repeatedly showed that teachers provided limited SRL strategy instruction (see Dignath & Veenman, 2021 for an overview). However, these analyses were done at the classroom level without considering the individual students. Another line of research on scaffolding interaction evidenced how teachers support students in applying learning strategies in small groups (Kajamies et al., 2017; Salo et al., 2022) or one-to-one tutoring situations (Abdoulaye, 2003). This study attempts to bring together the two perspectives and to examine if there are any overlaps between student and teacher reports of SRL, whether any regularities can be drawn from these perspectives via a person-oriented analysis, as well as to consider teacher attention distribution to individual students in relation to student SRL in the real-life classroom.

1.2 Self-regulated learning and related student behaviour

SRL is a concept that views learning as a process in which students actively regulate own thinking, emotional responses and behaviour, in order to complete academic tasks and improve continuously (Alexander et al., 2018). Several models have been proposed to explain SRL, where SRL is often considered as a multidimensional and cyclical process, in which students apply strategies to self-regulate and reach task goals (Panadero, 2017; Zeidner & Stoeger, 2019; Puustinen & Pulkkinen, 2001). Multidimensionality implies that when approaching academic tasks, effective learners not only engage in cognitive processing (e.g., perceiving, problem-solving, remembering), but also practice metacognitive monitoring and control, as well as regulate emotions that arise in the process. Emotional regulation is closely related to the motivational processes, such as finding interest in tasks, volitional control, and attributing failure or success to effort or ability (Pintrich & De Groot, 1990). The cyclical nature of SRL implies that, ideally, when regulating their learning, students go through certain phases (Pintrich, 2004; Winne, 2017; Zimmerman, 2002). For example, Zimmerman (2002) described three phases: forethought, performance and self-evaluation. In the forethought phase, learners identify the task goals, plan for reaching them, as well as activate motivational beliefs (e.g., task value) to engage with the task. During the performance phase, students cognitively work on the task and metacognitively monitor their progress in relation to the identified task goals. In the self-evaluation phase, learners reflect

on the result of the task and own performance, identify reasons for reaching or not reaching the goal, and how this can be improved further. Finally, to go through the above phases, students need to apply strategies to solve tasks (i.e., domain-specific cognitive strategies, Winne, 2017), to plan, monitor and reflect on activities (metacognitive strategies, Veenman & van Cleef, 2019), to acknowledge and change ones' motivational beliefs and to control emotions (motivational strategies, Pintrich & De Groot, 1990). Research shows that it is challenging for students to regulate own learning. Some students can engage in maladaptive regulatory behaviours, such as not applying learning strategies, keeping notes and study environment disorganised, procrastinating, or self-handicapping (Bembenutty, 2011), thus lacking self-regulatory skills (Martínez-Fernández et al., 2024). Hence, students need help in initiating and practicing SRL. In the classroom, this also may lead to a situation where students with different levels of SRL skills require different kinds of SRL support from teachers (Zimmerman, 2013; Vermunt & Verloop, 1999; Callan et al., 2022). Students with lacking SRL skills can become lost in the learning activities that require much autonomy, while students who are used to SRL may perceive additional support as over-teaching (Vermunt & Verloop, 1999; van de Pol et al., 2010; Peeters et al., 2016). In other words, teachers need to provide SRL instruction in an adaptive, calibrated way so that different students can benefit from it (Corno, 2008). The first step in planning optimal support is diagnosing students' current level of knowledge and SRL (van de Pol et al., 2010; Kajamies, 2017).

1.3 Student and teacher assessment of self-regulated learning

Measuring SRL is generally challenging (Veenman et al., 2006; Boekaerts & Corno, 2005). Understanding student SRL is important both for students and their teachers. There are mainly two approaches to measuring SRL: (1) as an aptitude, in a generalised way as experienced over time, reported at single time point, e.g., in a questionnaire, or (2) via directly following the process of learning, captured over a certain period e.g., with a think-aloud protocol (Winne & Perry, 2000; Panadero et al., 2016). Van Hout-Wolters (2000) made a similar distinction into offline and online measures. Although process-based and multimodal measures are introduced (Panadero et al., 2016), much evidence in the field of student SRL is collected via self-reports, as they can be used in combination with other methods. Besides, self-report measures tend to be informative for assessing global self-regulation rather than specific strategy use (Rovers et al., 2019). Considering the practical sides of measuring SRL, rigorous process-based assessment methods are not feasible in the school settings, so teachers and school psychologists would benefit from student self-reporting of SRL (Cleary, 2006).

Student SRL self-reports have been used in variable-based and person-oriented analyses. Application of SRL strategies and general perception of own SRL generally correlate with achievement (see Credé & Phillips, 2011 for an overview). However, as SRL is a dynamic process and students differ in their degree of practicing SRL, person-oriented analyses can be useful in distinguishing student SRL-profiles for intervening adaptively. In the study by Heirweg et al. (2019) with primary school students, clustering based on self-report questionnaires yielded four student profiles (i.e., active learners with high quantity motivation, active learners with high quality motivation, passive learners with low quantity motivation, passive learners with low quality motivation), while clustering based on think-aloud protocols revealed only two profiles (i.e., low and high SRL learners). At the secondary school level, similarly, connecting SRL and motivation, Ng (2016) distinguished four profiles of student procrastination and self-regulation: active procrastinator, active self-regulator, passive self-regulator, and passive procrastinator. Abar and Loken (2010) distinguished between high SRL, low SRL, and average SRL students, with high SRL students reporting high levels of mastery orientation while the low self-regulation group related more to avoidant goal orientation. Martínez-Fernández et al. (2024) showed that students who practiced self-regulatory behaviours were more satisfied with autonomous learning environments. Cleary et al. (2021) found relationships between student reported SRL and perceived school connectedness and support, identifying high SRL students with high levels of support, low SRL students who felt supported, solid SRL students with low support, and very low SRL students with low support. In another study, clustering student learning patterns based on the process trace data in the online environment were linked to different SRL needs of students: clusters with high SRL

indicators of task accuracy and knowledge development related to low support needs, and groups with low SRL indicators required more support (Dijkstra et al., 2023). Although there may be discrepancies between student SRL self-report and the process-based data from their actions during learning (Heirweg et al., 2019; Winne & Jamieson-Noel, 2002), student profiles based on self-reporting can help researchers and teachers to recognise the variety of student support needs.

Teachers are assumed to be able to make judgements about student SRL based on the daily school activities in a process-based manner, such as observing a student performing a task (Winne and Perry, 2000). When it comes to formal assessment methods, teachers are familiar with SRL self-report measures more than with process-based measures (Michalsky, 2017). Teacher ratings of student SRL behaviour can be used as an additional measure of student SRL. Zimmerman and Martinez-Pons (1988) used a teacher rating scale of student SRL based on Zimmerman's SRL model and found that student reports of using SRL strategies in structured interviews correlated with teacher ratings (r=.70). More recently, Cleary and colleagues (2021) applied teacher ratings to validate student SRL self-reports. In their study, teacher rating correlated with student reports of mathematics interest (r =.32), maladaptive regulatory behaviours (r =−.41), and test taking strategies (negatively worded, r =−.42). The overlap between student self-reports and teacher rating of student involvement in regulatory behaviours, such as planning, self-monitoring, organising environment for learning and seeking help has not been widely studied. Some of the SRL-related behaviours, like persistence, seeking help and feedback, being organised can be directly observed. Other more strategic processes of SRL related to cognition and metacognition are more challenging to spot. This also aligns with the findings that teachers usually are not trained to pay attention to learning processes and events that are indicative of SRL (Callan & Shim, 2019; Dignath & Sprenger, 2021). Therefore, teachers need to develop the capacity to notice indicators of SRL behaviour of students: whether and how students involve in the activities of planning, monitoring, and self-evaluating performance on a task (de Vries et al., 2022). This can be described as part of teacher professional vision.

1.4 Teacher professional vision for self-regulated learning

Professional vision (Goodwin, 1994) is a link between the professional knowledge and its application in particular situations. For teachers, it stands for noticing and interpreting key classroom events and interactions (van Es & Sherin, 2002; Seidel, & Stürmer, 2014). The mechanism for this is based on (1) selective attention to moments that are important for learning, e.g., changes in students' understanding, (2) teacher's pedagogical and content knowledge, connecting specific classroom interactions to the broad educational principles, and (3) using one's knowledge about the specific context to explain the interactions (van Es & Sherin, 2002). The latter emphasises the impact of each class conditions, student characteristics and behaviour on teacher's decisions during instruction, including support for SRL. Michalsky (2014) put forward a conceptual model that combined teacher professional vision with the framework of SRL instruction by Dignath & Büttner (2008). Greene (2021) included teacher professional vision to the set of factors that promote teacher's support of students' SRL in the classroom, along with teacher's epistemic beliefs, teacher's own self-regulation capacity and overall teaching competence. Teachers' SRL knowledge and teaching experience are shown to be predictors of teacher-reported SRL support in the classroom (Callan et al., 2022). At the same time, studies in Germany and the USA showed that teachers' understanding of SRL did not align with the academic conceptualisation of SRL, which also hindered their assessment of student SRL (Dignath & Sprenger, 2020; Callan & Shim, 2019). Teacher's prior conceptual knowledge about SRL also plays a crucial role for the noticing component of professional vision for SRL: pre-service teachers were able to distinguish between different types of strategy instruction in episodes of classroom videos after taking a course specialised on SRL in teaching (Michalsky, 2014), while teachers without a specialised SRL training were not able to correctly recognise strategy instruction, regardless of their level of expertise (Michalsky, 2021a). Michalsky (2021b) incorporated the professional vision lens into an intervention for scaffolding pre-service teachers' capacity to teach metacognitive and strategic knowledge to students. Their results showed that those pre-service teachers who reflected on both teachers' and

students' behaviours in the video-based learning materials improved the skill for teaching strategies to students, which also led to better student outcomes. Such effect was not observed in pre-service teachers whose reflections on classroom videos focused only on teachers' behaviours. This study highlighted the importance of analysing student behaviours in teachers' capacity to promote SRL. Hence, professional vision for SRL brings the discussion on SRL to the practical domain: it is not only important for teachers to know about SRL and how to incorporate it in their teaching, but also how to notice indications of SRL in their students.

1.5 Teacher visual attention to students in the classroom

Teacher visual attention in the lesson can be considered as part of the noticing component within teacher professional vision (Seidel et al., 2021; Chaudhuri, 2023). Visual attention is a prerequisite of noticing important events or student characteristics. Both screen-based and mobile eye-tracking methods have been helpful in studying teacher noticing and visual attention (Grub et al., 2020). Eye movement events, such as fixations and saccades, are quantified or examined in scanpaths to follow the focus of teacher visual attention when observing classroom videos, or directly in the process of teaching, captured by the mobile eye tracker (Minarikova et al., 2021). The number and duration of fixations on different targets in the classroom are often used as indicators of teacher visual attention in research. Fixations are periods of time when the eye is relatively still and acquires new information from the environment, they are the basis of visual attention (Holmqvist et al., 2011; Duchowski, 2007). Another possibility is the visit metric that comprises all fixations in an area of interest (AOI) between the gaze entry and exit of this AOI, with at least one fixation in the AOI (Telgmann & Müller, 2023; Maatta et al., 2021). It is a less sensitive visual attention parameter that represents teacher's "look" at a student.

Screen-based studies on teacher professional vision, especially within teacher expertise research, revealed how teachers' general knowledge relates to their visual processing of classroom scenes. Expert teachers tend to pay more attention to students rather than other areas in the classroom (van den Bogert et al. 2014; Wolff et al., 2016). When assessing student learning profiles, expert teachers monitor more students and show recurring scanning patterns on students, as well as judge student learning dispositions more accurately compared to novices (Kosel et al., 2021). Besides, experienced teachers notice a higher number of student behavioural cues it the lesson, such as hand-raising, while actively monitoring all students (Kosel et al., 2023). In standardised and simulated teaching situations, pre-service teachers tended to focus more on actively participating students and avoid quiet, uninterested, or disrupting ones (Goldberg et al., 2021). Besides, experienced teachers can recognise subtle changes in students' engagement and variation in the quality of answers (Seidel et al., 2021).

In the real-life classroom, teachers work with students over extended periods of time, building context-specific knowledge about their students as individuals. Mobile eye tracking research directly in the classroom allows capturing teacher visual attention in the authentic uncontrolled classroom conditions (Pouta et al., 2021; Huang et al., 2021; McIntyre et al. 2017; McIntyre et al. 2019; Cortina et al., 2015). Another advantage of mobile eye-tracking research is the possibility to relate teacher visual attention to student-specific information, such as student achievement, learning needs and behaviours. Dessus et al. (2016) considered student achievement level and teacher ratings of student self-regulatory behaviours as factor that affected teacher's gaze allocation between students. The study concluded that more experienced teachers were more likely to distribute gaze based on the student characteristics, but the gaze and student characteristic association was rather weak. At the same time, Smidekova et al. (2020) found no association between teacher visual attention and achievement level across several lessons of the same teacher. In the study by Chaudhuri et al. (2022), teacher's fixation counts on the students correlated positively with the amount of teacher-reported individual support to students, and negatively with student scores on math and literacy tests. Thus, eye-tracking research shows possible associations between teacher visual attention and student-related characteristics.

1.6 Research questions

The goal of this study is to investigate the noticing component of teacher professional vision in relation to student SRL. In the first step of the study, we aim to identify the degree of agreement between student self-report and teacher rating of student SRL. In the second step, we focus on the association between teacher visual attention and student SRL (represented as student self-report, teacher rating, and identified joint SRL-profile).

For the purposes of examining teacher visual attention in relation to student SRL in the classroom as part of the noticing component of professional vision, both student self-reports and teacher ratings could be applied. On the one hand, student self-reports have been extensively used in the research on SRL. On the other hand, teacher ratings of student SRL represent teachers' judgments of student SRL based on observing student learning over time and are part of teacher context-specific knowledge. Previous research shows some degree of association between teacher ratings of student learning-related characteristics and teacher visual attention (Dessus et al., 2016; Chaudhuri et al., 2022). Furthermore, previous studies that correlated student SRL self-report with teacher ratings did not focus specifically on the relation between student and teacher assessment of student planning, self-monitoring, and help-seeking strategies, in addition to maladaptive regulatory strategies. Thus, the research question that explores the extent of the relationship between the student-reported and teacher-rated measures has been formulated:

RQ1a To what extent do student self-reports and teacher ratings of student SRL coincide?

A potential mismatch between the student self-report and teacher rating can signify students' misestimation of own SRL (Winne & Jamieson-Noel, 2002), or a need for calibration in teacher's understanding of students SRL involvement. To our knowledge, no previous studies explored the relationship between teachers' and students' assessment of student SRL in person-oriented analyses. To draw a picture of different student subgroups that form SRL-profiles based on combining measures from student and teacher perspectives, the research question was formulated:

RQ1b Which student SRL-profiles can be identified based on student self-report and teacher rating of student SRL?

Further, to investigate teacher professional vision in relation to student SRL directly in the classroom, we examine whether the amount of teacher visual attention as part of teacher noticing is related to student SRL. We examine teacher visual attention in relation to student SRL as reported by students, as well as teachers:

RQ2a Is there an association between teacher visual attention and student SRL (self-reported and teacher rated)?

As some variation between teacher rating and student self-report of SRL can be expected, resulting in student SRL-profiles, it is also important to consider this variation in relation to teacher visual attention in the classroom:

RQ2b Is there a difference in teacher visual attention distribution between the identified student SRL-profiles?

2. Methods

2.1 Research design, participants, and procedure

Participants in this study were 10 (female N=8) teachers and their students (N=158) at the high school level in Lithuania. The participating teachers and their students were recruited from the university partner schools network following convenience sampling strategy. The participating classes were 9th and 10th grades, with students of 15 – 16 years of age. Teachers taught different subjects, such as English, Mathematics, Biology, Physics and Lithuanian. Teachers' work experience varied from 2 to 22 years

(M=8.2; SD=6.95), all of the teachers had at least a Bachelor's degree and teacher qualification, meeting the minimum state requirements. The signed informed consent forms to participate in the study were collected from teachers, students, and student parents (guardians).

The first author attended two lessons of each teacher. In the first lesson, the teachers and students were informed about the study, filled in questionnaires, and were familiarised with the eye-tracking equipment. In the second lesson, the teacher was asked to teach the lesson as usual while wearing the eye-tracking glasses. Before the start of the lesson, the researcher helped the teacher to put on the glasses and performed the one-point calibration (Tobii Pro AB, 2021a). The teacher was instructed to not move the glasses during the recording time. The researcher was present in each lesson that was recorded. The recording length was on average 39 minutes.

Tobii Pro Glasses 3 eye tracker was used in all classes. This is a mobile eye tracker resembling usual glasses with a front-looking camera (resolution 1920 × 1080 at 25 fps), a microphone, an eye-tracking system for both eyes (two eye cameras and eight infrared illuminators per eye), and a recording unit connected via cable to the glasses frame. The tracker captured eye movement at 100 Hz sampling rate with accuracy of 0.6°. The system was operated wirelessly from researcher's computer (Tobii Pro AB, 2021a).

2.2 Measures

2.2.1 Questionnaires

Student self-report of practicing self-regulated learning. Students filled in Self-Regulation Strategy Inventory – Self-Report (SRSI-SR; Cleary, 2006). It is a 28-item questionnaire with 7-point Likert scale (Almost never to Almost always), divided into three subscales. The initial internal reliability of the questionnaire reported in its validation study was α=.92, subscales ranging from .72 to .88 (Cleary, 2006). This questionnaire has been selected because it focuses on both overt and strategic student behaviours associated with SRL and has a corresponding validated teacher rating scale (SRSI-TR, see below). The subscale Managing Behaviour and Environment included 12 items, with acceptable alpha of .80 in the present sample. This subscale aimed to capture how often students reported self-regulated behaviours such as organising time and environment when studying ("I make a schedule to help me organise my study time") and strategic behaviours ("I tell myself exactly what I want to accomplish before studying"). Subscale Seeking and Learning Information included 8 items (α=.60 in the present sample) with items focusing on students' help seeking behaviours ("I ask my teacher questions when I do not understand something"). Finally, subscale Maladaptive Regulatory Behaviours included 8 items (α =.62) and elicited reports of low regulatory behaviours ("I wait to the last minute to start studying for upcoming tests").

Teacher rating of student self-regulated learning. Teachers were asked to fill in Self-Regulation Strategy Inventory – Teacher Rating Scale (SRSI-TR; Cleary, & Callan, 2014) about each student. The initial questionnaire included 13 items, one item about student attendance of extra consultations was excluded as such consultations were not a common practice at participants' schools. The questionnaire used 5-point Likert scale (Almost never to Almost always). The original scale was unidimensional, however, for the purposes of this study, exploratory factor analysis was conducted and identified two subscales corresponding to the student questionnaires: Managing Behaviour and Motivation (7 items, α=.96) and Seeking and Learning Information (5 items, α=.93). These instruments are less widely used than other SRL questionnaires (Tise et al., 2019) and have not been translated into Lithuanian previously. The items were translated by a professional translator into Lithuanian, and then back into English, the meaning of the items was found to be preserved.

2.2.2 Eye-tracking measures

Visit metric in Tobii Pro Lab software was used to describe teachers' eye movement in relation to areas of interest (AOI) in the classroom. Visit is defined as "all the data between the start of the first fixation inside and AOI to the end of the last fixation in the same AOI" (Tobii AB, 2022, p. 124). Visit

metric was used in previous eye-tracking studies in the classroom (Smidekova et al., 2020). Two measures based on the visit metric were used: number of visits (or visit count) and visit duration measured in seconds (total and average duration per AOI in a time interval).

2.3 Data analysis

2.3.1 Eye-tracking data processing and coding

The mobile eye tracker yielded a video recording of the lesson from the teacher's perspective with gaze overlay and audio. This recording was used for coding teacher gaze. The videos with gaze overlay were analysed in Tobii Pro Lab software (version 1.194, Tobii AB, 2022). Tobii I-VT Attention Filter has been used, as it is designed for differentiating fixations in dynamic recording conditions. Thus, according to filter settings, eye-tracking data points above the velocity threshold of 100 degrees/second and minimum length of 60 milliseconds were classified as fixations (Tobii AB, 2022). The first author coded each fixation according to the AOI it was in, the AOIs included (previously used in McIntyre et al., 2019 and Muhonen et al., 2020): *student* (face and body), *student material* (worksheet, book, hands with pens during writing), *board* (white/black/smartboard and projector screen), *teacher material* (lesson plans, notes, books, teacher's computer screen), *other* (non-instructional targets like windows). Moments, when the gaze cursor was outside of the screen were coded as *unsampled*, this code comprised from 0.3 to 5.2 percent of all fixations across teachers. Three teachers had logistical situations in the lesson, when they were checking attendance or solving technical problems with the computer, so these intervals were excluded from analyses (5 min 6 sec in total). To ensure the reliability of the coding procedure, pre-defined rules for identifying AOIs were followed (similar procedure to Chaudhuri, 2023). Fixation codes were used for calculating visit metrics in the software. The present study focused on teacher's gaze at students, so the codes *student* and *student material* were combined into the overall *student* metric, as student material areas were relevant for learning situations in the lesson, but not emphasised in the research questions.

2.3.2 Statistical analyses

To examine the association between student self-report and teacher rating, Pearson correlation and k-means cluster analyses were applied. The relation between SRL scores and teacher attention indicators were examined with Pearson correlations and Kruskal-Wallis H test. All analyses were performed in IBM SPSS (v. 28.0.1.1). Standardised scores were used for all analyses as student and teacher questionnaires used different scales.

3. Results

The descriptive information about the analysed variables is presented in Table 1.

Table 1

Descriptives

	M (SD)	Min.	Max.	Skewness	Kurtosis
Questionnaire data					
SR: Managing Behaviour and Environment	4.48(.99)	1.17	6.67	-.346	.460
SR: Seeking and Learning Information	4.66(.93)	1.25	6.63	-.461	.586
SR: Maladaptive Regulatory Behaviours	2.96(.84)	1.00	4.88	.187	-.604
TR: Managing Behaviour and Motivation	3.67(1.07)	1.00	5.00	-.701	-.336
TR: Seeking and Learning Information	3.62(1.11)	1.00	5.00	-.874	-.075
Eye movement data					
Number of visits	92.5(69.3)	9.00	448.00	1.663	4.044
Total visit duration (s)	59.9(43.3)	2.92	304.00	1.888	4.729
Average visit duration (s)	0.64(0.30)	.25	1.80	1.962	4.482

Note: SR – student self-report, 7-point Likert scale; TR – teacher rating, 5-point Likert scale.

3.1 To what extent do student self-reports and teacher ratings of student SRL coincide?

A correlation analysis was performed to explore the relationships between student self-report and teacher rating subscales (Table 2). It showed that scores correlated within student self-reports and teacher ratings, but not between these two perspectives, except for student-reported Maladaptive Regulatory Behaviours scale that was slightly negatively correlated with teacher ratings (r=−.275). There was a marginally significant correlation between student-reported Seeking and Learning Information behaviours and teacher-rated Managing Behaviour and Motivation scale (r=.133, p<.1).

Table 2

Pearson correlations between student self-report and teacher rating subscales

	TR: Managing Behaviour and Motivation	TR: Seeking and Learning Information
SR: Managing Behaviour and Environment	.056	.066
SR: Seeking and Learning Information	**.133†**	.110
SR: Maladaptive Regulatory Behaviours	**-.275****	**-.228***

Note: SR – student self-report; TR – teacher rating, * p<.001, ** p<.005, † p < .1.

3.2 Which student SRL-profiles can be identified based on student self-report and teacher rating of student SRL?

Four student SRL-profiles were identified through k-means cluster analysis (Table 3; Fig. 1). In the initial analyses, different numbers of clusters were considered in an iterative process, and the 4-cluster solution was then selected as the most informative. The difference between the profiles appeared based on the extent to which teacher's rating coincided with student report: two profiles where students' self-reports and teacher's ratings were in the same direction (Systematic higher-regulated and Systematic lower-regulated profiles), and two profiles where either students' scores were higher than teacher's (Mixed lower-regulated) or students' scores were lower than teacher's (Mixed higher-regulated), with the latter being the largest group (student N=72).

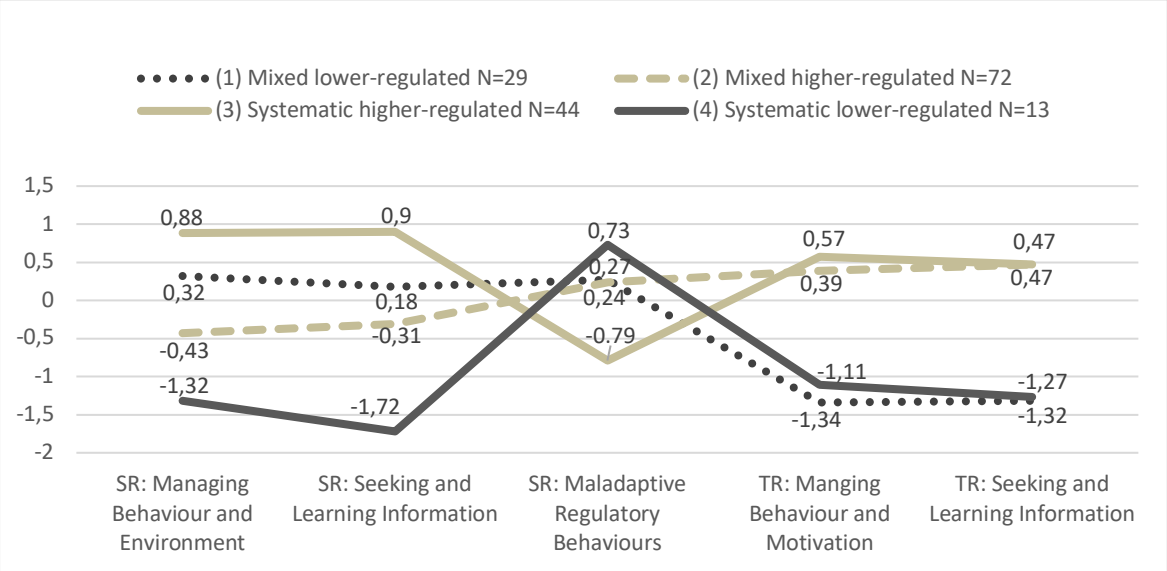

Figure 1. Identified student SRL-profiles.

The mixed student profiles identified in the cluster analysis above show that students may report both self-regulated and maladaptive behaviours, while correlation analyses show a negative correlation between these two types of behaviour. Hence, the person-oriented cluster analysis has provided a more fine-grained picture of self-regulation than the variable-oriented correlation analysis, demonstrating that self-regulatory behaviours are not dichotomous, as students report self-regulatory behaviours along with maladaptive ones.

Table 3

Student SRL-profiles based on standardised mean scores of student self-report and teacher rating subscales

	Student profile			
	(1) Mixed lower-regulated	(2) Mixed higher-regulated	(3) Systematic higher-regulated	(4) Systematic lower-regulated
	N=29	N=72	N=44	N=13
SR: Managing Behaviour and Environment	.32	-.43	.88	-1.30
SR: Seeking and Learning Information	.18	-.31	.90	-1.72
SR: Maladaptive Regulatory Behaviours	.27 [A]	.24 [A]	-.79	.73 [A]
TR: Manging Behaviour and Motivation	-1.34 [D]	.39 [B]	.57 [B]	-1.11 [D]
TR: Seeking and Learning Information	-1.32 [E]	.47 [C]	.47 [C]	-1.27 [E]

Note: SR – student self-report; TR – teacher rating
A – no significant difference between Profile 1, Profile 2 and Profile 4; Profile 3 significantly different from the rest
B, C – no significant difference between Profile 2 and Profile 3
D, E - no significant difference between Profile 1 and Profile 4

The ANOVA procedure with post-hoc Scheffe's test showed that not all mean scores were significantly different across profiles (see notes in Table 3). From students' perspective, all profiles are significantly different in the mean scores of student-reported Managing Behaviour and Environment and Seeking and Learning Information scales. Noticeably, positive student-reported Maladaptive Regulatory Behaviours scores in profiles 1, 2 and 4 are not significantly different across these three profiles, but the negative score in profile 3 (Systematic higher-regulated) is significantly different from the other three ($p<.001$). From teachers' perspective, two groups are distinct: higher-SRL students (including both mixed and systematic, profiles 2 and 3 combined) and lower-SRL students (including mixed and systematic, profiles 1 and 4 combined), as teacher rating mean scores within each pair are not significantly different. It can be observed that teachers' positive ratings are close to average even for the Systematic higher regulated profile, while the negative ratings are strong, being lower than average by more than 1 SD. The two mixed groups combined (N=101) are larger than systematic ones (N=57), indicating that teacher and student assessments tend to not coincide.

3.3 Is there an association between teacher visual attention and student SRL (self-reported and teacher rated)?

The correlation analysis showed mostly no association between the teacher gaze indicators and student SRL scales, except the teacher rating scale Seeking and Learning Information, as seen in Table 4. The number of the gaze visits and the total visit duration per student showed slight positive correlations ($r=.222$ and $r=.172$ respectively), indicating a connection between teacher's rating of a student as someone who frequently asks questions in class and the amount of teacher's attention to that student.

Table 4

Pearson correlations between teacher attention indicators per student and student SRL

	Teacher attention indicators		
	Number of visits	Total visit duration (s)	Average visit duration (s)
SR: Managing Behaviour and Environment	.001	.033	.040
SR: Seeking and Learning Information	-.064	.001	.106
SR: Maladaptive Regulatory Behaviours	-.011	-.002	.044
TR: Manging Behaviour and Motivation	.102	.037	-.098
TR: Seeking and Learning Information	**.222****	**.172***	-.027

Note: SR – student self-report; TR – teacher rating, ** p < .001, * p < .05

3.4 Is there a difference in teacher visual attention distribution between the identified student SRL-profiles?

Non-parametric Kruskal-Wallis H test was used to check whether there were differences in teacher visual attention indicators between the identified student profiles, resulting in no significant differences for the number of visits (H(3)=.873, p=.83), total visit duration (H(3)=1.40, p=.70), and average visit duration (H(3)=1.08, p=.78) between the profiles.

4. Discussion

This study focused on the role of students' SRL-related behaviour in teacher professional vision in terms of how teachers assessed student SRL, and whether this related to teacher's visual attention distribution on students during the lesson. It was found that, first, teacher ratings of SRL behaviour differed from student self-reports, shown both through correlations and person-oriented analyses. Second, analysis of the mobile eye-tracking data showed that teachers' gaze visit count and total visit duration were moderately associated with teacher rating scale that described students' tendency to ask questions and seek help in the lessons.

The first research question addressed the degree of agreement between student and teacher assessment of SRL, including what kinds of student SRL-profiles could be identified based on SRL reporting from student and teacher perspectives. The results showed that generally, there was a small overlap between the two assessment perspectives, demonstrated by most students having a mixed profile. This finding is somewhat in alignment with previous research reporting teachers' difficulty to differentiate between student ability and achievement (Lavrijsen & Verschueren, 2020) or to accurately rate student well-being (Urhahne & Zhu, 2015). Furthermore, teachers' judgments of student achievement tend to be more accurate than judgments of student motivation and engagement (Kaiser et al., 2013). However, the student questionnaire included items that related not only to classroom learning, but also to homework and preparing for tests, while teachers could rely only on student behaviour at school as the basis for rating, which could lead to the differences in judging students' SRL behaviour. Reports of maladaptive behaviours appear to be the most distinctive in the analyses. Two systematic student profiles, i.e., where teacher and student SRL assessment were in the same direction, show the highest (for the lower-regulated profiles) and the lowest (for the higher-regulated profiles) scores of the maladaptive behaviours. Besides, the latter was the only student report subscale that correlated with teacher rating. This is consistent with the study by Cleary et al. (2006), where the present teacher rating instrument was initially used and negatively correlated with the student-reported Maladaptive Regulatory Behaviours subscale (r=−.41). This may also indicate that the maladaptive student

behaviours are more salient for teachers than the strategic ones, thus teachers tend to notice the former. This is also similar to the research showing that teachers partly rely on the off-task behaviour to diagnose students' SRL (Dignath & Sprenger, 2020).

The second research question investigated whether teachers' visual attention distribution and reports of student SRL were related. The only association identified was with Seeking and Learning Information subscale of teacher rating, while no significant correlations were found with the other teacher rating subscale (Managing Behaviour and Motivation) or any of the student self-report subscales. This finding also shows that teacher's perspective, this time in form of attention allocation to students in the classroom, has a connection to a fairly salient student trait – the tendency to seek information in the classroom – rather than to the relatively covert cognitive and metacognitive regulatory behaviours. The previous mobile eye-tracking classroom studies showed mixed results for the relationship between the amount of teacher gaze and student characteristics: no association with the student achievement level (Smidekova et al., 2020), a weak association with student self-regulated behaviour for experienced teachers (Dessus et al., 2016), a moderate association with student academic skills (Chaudhuri et al., 2022). All these studies reported results from the primary school classrooms. The present study focused on the high school classrooms, where teachers may have different expectations to students and how students demonstrate needs for support. The higher the level of education, the more teachers tend to focus on the study content rather than on the learners (Oolbekkink-Marchand et al., 2007). Moreover, SRL involvement may be more subtle than student achievement and academic skills. Considering the above discrepancy between teacher and student SRL assessment, teachers may not reason about students in the SRL-related categories when teaching the lesson, especially with the previous studies showing that teachers generally have limited conceptual knowledge of SRL processes (Dignath & Sprenger, 2020; Callan & Shim, 2019). Thus, on the one hand, there may be other student behaviours rather than their usual SRL-related practices that attract teacher attention at any given moment in the lesson. Also, it is known that more factors, such as student verbal participation (Muhonen et al., 2020), teacher movement in the classroom (Huang et al., 2023), student position in the classroom (Smidekova et al., 2020), and instructional format (Stahnke & Blömeke, 2021) impact teacher visual attention allocation in the classroom. On the other hand, teachers may be carrying out their lessons as planned, aiming for distributing attention between all students, following more of a top-bottom perspective. There is evidence that experienced teachers can accurately recognise student disengaged behaviour and gaze more on students who appear uninterested or struggling (Seidel et al., 2021). Still, even if teachers have the knowledge about their individual students' learning, they may choose not to concentrate on student differences in the lesson and have strategies to address those differences in a more long-term perspective, not captured in the recorded lesson. It is important to note that teachers in the present study taught different subjects. The previous studies show that teachers have different priorities depending on the subject taught, which is reflected in visual behaviours. Stahnke & Friesen (2023) reported that expert biology teachers focused more on looking for strategies in the classroom management, especially for organising activities and setting up the classroom effectively, while mathematics teachers were concentrated on managing student behaviour and ensuring student participation, which led to variations in attention allocation. In addition, teachers had more frequent and longer fixations on student and student material in the literacy classes comparing to the math classes (Huang, 2018). Thus, the nature of the subject taught might have created an additional variation in teachers' attention to students in general, as well as to particular students.

Finally, the teacher gaze distribution at the classroom level may not be representative of noticing specifically for SRL considering the various factors that influence teacher visual attention in the classroom. As the eye movement measures represent both voluntary and involuntary overt attention (Duchowski, 2007), triangulation with other data sources, such as verbal reports, can be useful. For example, retrospective stimulated recalls with teachers guided by the lesson recording may shed light on teachers' rationale behind the visual attention to students and the instructional intentions. Thus, more contextualised, and possibly qualitative analyses are needed to connect the instruction, student SRL-profiles, student behavioural cues and teacher noticing. Nevertheless, by taking the novel approach of incorporating multiple measures and perspectives, this study demonstrates the potential of combining

the questionnaire data with the eye-tracking measures to discern the areas of student SRL that are more and less noticeable for teachers.

Overall, theoretically, this study contributes to the development of the evolving field of teacher professional vision for SRL (Greene, 2021; Michalsky, 2014). Methodologically, it innovatively combines the data on student SRL from students and teachers, as well as the process-based measures of teacher visual attention from the authentic classrooms.

5. Limitations, methodological considerations, and implications

The present study had several limitations. First, a rather limited sample of 10 teachers can be sensitive to the variability in teacher gaze behaviour and lesson settings and does not provide a possibility to generalise findings. Besides, the student overt behaviours in the classroom during lesson recording that had a direct effect on the teacher gaze were not coded, thus the future studies on SRL in the classroom could utilise additional ratings of student behaviours, also to explore the relationship between the overt engagement cues and the reported SRL. Besides, as SRL can be both a situational and a long-term process, longitudinal analyses could reveal trends of teacher's recognition of student SRL practices and traits. Another limitation is related to questionnaire reliability. Two of the student questionnaire subscales had marginal reliability of .60 and .62, which is lower than in the original validation study. This could be due to the change of context where the questionnaire was administered, as it was developed for the USA context and this study took place in Lithuania. Other studies that used the inventory outside of the USA also reported lower reliabilities (for example, α=.66 in Israel reported by Madjar et al., 2011).

There are methodological considerations related to the authentic classroom conditions of the study. The real-world classroom provided a high ecological validity (Jarodzka et al., 2017), still the high variability in the school subjects, teacher behaviours, lesson durations and different lesson phases could influence the results. Furthermore, the mobile eye-tracking technology is an innovative tool for data collection, but it is important to note that identification of fixations as attention points of the participant largely depends on the event detection algorithm of the data analysis software. The visit metric used for reporting gaze in the present study was considered informative in the classroom settings, as it captured how many times a teacher entered the student AOI, i.e., looked at the student, rather than made individual fixations on the student. At the same time, the visit metric calculated by the software included not only fixations inside one AOI, but also saccades and blinks (Tobii AB, 2022). This is natural for looking in the real-world settings, however, it reduces the possibility to compare results with other classroom mobile eye-tracking research.

This study adds to the line of research on teaching for SRL, carrying implications for teacher education and further research. The first implication is the need for developing teacher professional vision for SRL, and with this bringing the student SRL-related behaviours to the focus of teachers, both in regard to teacher selective attention as a bottom-up process, and knowledge about SRL for building the top-down perspective. This study has shown that teachers are more prone to noticing salient and maladaptive behaviours of students, highlighting the need for teachers to learn to notice the variations in the regulatory student behaviours and the cognitive, metacognitive, and emotional learning strategy application. One of the steps to promote this can be the development of teachers' conceptual knowledge on SRL (Karlen et al., 2020) and using SRL as an additional lens for interpreting student behaviours, including maladaptive or disruptive ones. This means that teachers would need to consider student participation in the lessons beyond behavioural engagement as being on-task and following the rules, to the cognitive engagement (Fredricks et al., 2004). To this end, interventions can be designed to foster teacher professional vision development for SRL for in-service teachers, similarly to the training of the pre-service teachers reported by Michalsky (2021). Another possibility is to investigate teacher misconceptions about the concept of SRL and SRL of students (Vosniadou et al., 2020) drawing on teachers' classroom experiences, e.g., following action research approaches. Further research on

assessing and teaching SRL in the authentic classroom conditions could focus on capturing moments in student participation related to SRL, as well as teachers' activities and verbalisations aimed at SRL support, and how those interconnect with student learning.

Keypoints

- Using teacher and student perspectives for assessing SRL highlighted the subtleness and complexity of student SRL.
- According to SRL-profiles, students can use both self-regulatory and maladaptive strategies, which challenges teachers in assessing student SRL.
- Teacher ratings and eye movement show that teachers mostly notice student help-seeking in the classroom.

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