SCIENCE AND MATH TEACHERS' PERFORMANCE ASSESSMENT ABOUT STUDENTS SELF-DIRECT LEARNING

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Abstract
The aim of the present paper is to build knowledge on the possible ways how in-service teacher performance gaps regarding teaching 21st century skills and basic skills, may be identified, in order to minimize them through building evidence-based and personalized teacher professional development. Insights were gained from a school-based research, identifying science and math teacher (N=103) knowledge – performance and self-assessment – performance gaps and the consequent professional development solutions. Lesson observations and a test questionnaire were used to obtain necessary data. As a result, authors show what is the observed difference between science and math teacher performance, knowledge and self-evaluation according to self-direct learning and basic skills.
Key words: self-direct learning, performance assessment, personalized professional development.

1 Introduction
Latvia like other nations is experiencing a curriculum change (Nieveen, & Plomp, 2018) that features a center on 21st century attitudes, complex utilize of information, attitudes, states of mind and values, and students' capacity to solve complex issues in changing real-life settings. Educator performance within the classroom plays a noteworthy part in an effective execution of the change (OECD, 2016). One of the most influential factors for students learning outcomes is teaching. Unfortunately, not only a difference between teachers' performance in teaching (Namsone, Čakāne, Volkinšteine, & Butkēviča, 2018), but also a gap between teachers' knowledge and observed teaching (Dudareva, Namsone, Butkēviča, & Čakāne, 2019) is perceived in previous studies. With a curriculum reform currently taking place in the country, it is important to obtain credible data to characterize teachers' ability to implement the planned changes and their professional development needs. A category-criteria framework relevant to the context of changes is therefore required to further deliver professional development (PD) (Cauglan, & Jiang, 2014). In order to have an impact of PD on the classroom practice, the time for more personalized PD for science and math teachers is required (Kunter, 2013; Lipowsky, & Rezjak, 2012). In this paper authors identify differences in science and math teachers self-direct learning and basic teaching skills using teacher performance assessment and test questionnaire. Furthermore, providing successful implementation of reform considering that the reform prioritizes complex learning outcomes including self-direct learning.

2 Theoretical framework
This study employs the Framework of Teacher Performance Assessment to Support Teaching 21st Century Skills (designed by the authors; Bērtule et al., 2019), consisting of 8 categories (identified with "I A" or "I B") that are characterized with 13 criteria and structured in three domains of teaching practice – planning (1), teaching (2), classroom environment (3).
Also, approved performance level descriptors (PLDs), on a scale from 1 to 4, offer assistance to decide the teacher's level of performance in understanding to the criteria created, and thus informs about teacher's competence. To assess teachers' performance, this study focuses on two categories and selected criteria for each – IA1 "Self-directed learning" is assessed

according to criteria 1.1."Learning goals" and 1.3. "Feedback to students"; IB5&IB6 "Teaching techniques and basic skills" is assessed according to 5.1. criteria "Lesson design" (as part of planning) and 5.2. – "Teaching techniques" (as part of teaching).
Aim: to identify differences in science and math teachers basic teaching skills and self-direct learning.
Research Question: What is the observed difference between science and math teacher performance, knowledge and self-evaluation according to self-direct learning (IA) and basic skills (IB)?

3 Research methods

1.Field work: 6 experienced (7-17 years) and trained experts observed, transcribed and analysed lessons according to a procedure and PLDs from September 2017- November 2019. 2.Data analysis: obtained data was encoded, compiled, processed. 3.Expert focus group:
Study sample consists of 4 sub-samples of science and math teachers from different municipalities: 32 maths teachers (24 schools, 7th – 9th grade, 13-15 years old); 14 maths teachers (12 schools, 10th – 12th grade, 16-18 years old), 43 science teachers (40 schools, 7th – 9th grade), 14 science teachers (13 schools, 10th – 12th grade). 4. Test questionnaire (TQ): The test-questionnaire was validated and improved in previous research (Butkēviča et al., 2019). The difficulty level and resolution of the test-questionnaire is suitable. If TQ knowledge questions were filled out 100% correctly then the teacher acquired 4 points, if 75% then 3 points, if 50% then 2 points, if 25% then 1 point. In TQ self-assessment the answers chosen by the teacher indicate that the way he/she would act in these learning situations in the classroom correspond to a certain level of performance (on a scale 0-4). Limitations of the research: the framework and test-questionnaire are tested in 3 teacher samples representing one country, results may differ if tested elsewhere. The TQ doesn't include evaluation items regarding teacher's self-assessment of criteria 5.1. and teacher's knowledge in criteria 5.2.

4 Results

In Table 1 science and math teachers average performance in observed lessons based on PLD levels according to the selected categories (IA, IB) and criteria (1.1., 1.3., 5.1. and 5.2.) and their TQ results about self-direct learning and basic skills implementation in lessons are demonstrated. Results are divided in four groups of classes (Science (Sc) and Math (M) 7^{th}-9^{th} grade; Science (Sc) and Math (M) 10^{th}-12^{th} grade).

Table 1. Science and math teachers' average performance in lesson observations and average results from TQ according to basic skilss and self-direct learning.

Criteria	1.1. Learning goals				1.3. Feedback to students				5.1. Lesson design				5.2. Teacher techniques			
	Sc7-9	M7-9	Sc10-12	M10-12	Sc7-9	M7-9	Sc10-12	M10-12	Sc7-9	M7-9	Sc10-12	M10-12	Sc7-9	M7-9	Sc10-12	M10-12
Lesson observations	1,49	1,25	1,67	1,67	1,35	1,29	1,08	1,58	1,79	1,61	2,42	2,08	1,51	1,74	2,17	2,00
TQ knowledge	0,94	0,95	0,67	0,90	1,18	1,36	1,08	1,25	2,45	1,71	2,42	2,40				
TQ self-assesment	3,10	3,29	3,25	3,00	3,10	1,36	2,42	3,60					1,81	2,14	1,75	1,80

The results of each science and maths teacher group were visualised as seen in the examples in Figures 2 and 3, to analyse the gaps between teaching practice, knowledge and self-assesment.

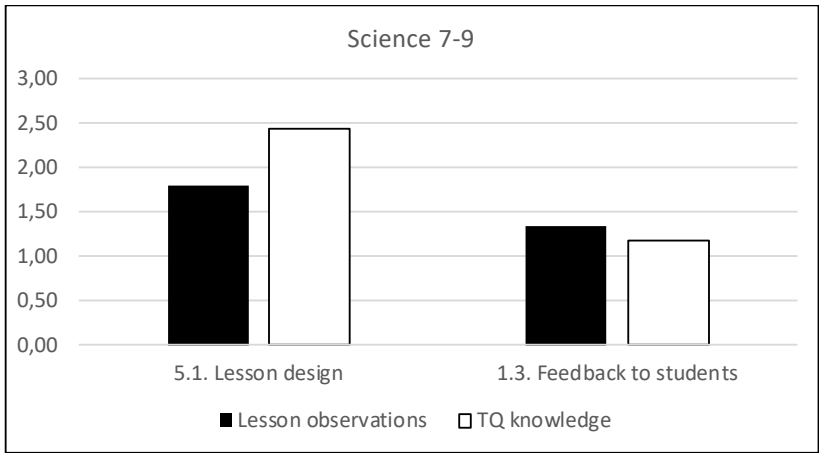

Figure 2. Differencies between 7-9th grade science teacher lesson observations and knowledge.

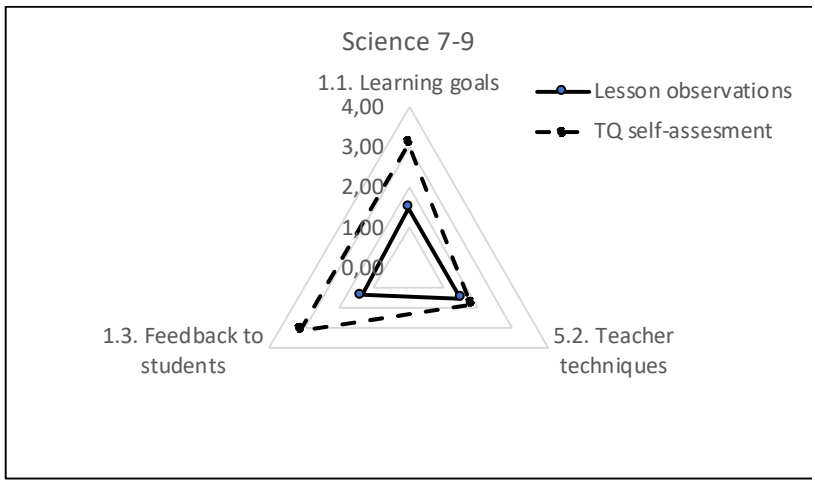

Figure 3. Differencies between 7-9th grade science teacher lesson observations and self-assesment

5 Discussion and conclusion

The TQ and lesson observations show similar results between the four science and math teacher groups. The level of knowledge about self-directed learning is low between science and math teachers (none of the groups reach level 2). In all groups the observed teaching was better in criteria corresponding to category IB (criteria 5.1. and 5.2.) than category IA (criteria 1.1. and 1.3.). This difference can detain successful implementation of the oncoming curriculum change in math and science subjects, where effective feedback to students (criteria 1.3.) is seen as an everyday practice. A gap between teaching practice and knowledge regarding basic teaching skills can be observed among science and math teachers. All of science teachers and most of math teachers reach level 2 in TQ regarding knowledge about basic teaching skills, still the experts haven't observed such teaching. The observed level of 10^{th}-12^{th} grade teachers self-directed learning exceeds their knowledge about it, leading to a hypothesis about role of intuition in their practice. Most of the teachers evaluate their practice in self-directed learning and basic skills at least one level higher than observed, leading to a conclusion about lack of self-reflection skills between science and math teachers. International comparative research shows gap – performance differences between teachers (OECD, 2019) also authors' own empirical research in the Latvian context has shown remarkable gaps in teachers' performance levels (Dudareva, Namsone, Butkēviča, & Čakāne, 2019) thus confirming appropriate use of methods. The usage of framework and PLDs for teacher testing will be continued to be used not only for self-assessment and for the development of teacher competencies according to

school goals and personalized teacher professional development. The use of methods described in this paper will continue in further research in different subject groups and school-level research.

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