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**Measuring pre-service teachers' general pedagogical
knowledge—What are the results telling?**

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Abstract

A pilot study was carried out in order to attempt capturing teachers' general pedagogical knowledge (GPK). The aim of the paper is to find out how pre-service teachers' GPK differs within internship experience, level of education and work experiences, and what can be concluded about the test instrument based on results. All together 135 pre-service teachers from Estonia filled in a knowledge test with 60 multiple choice questions. The results showed that those who had not done their internship performed better at the test, possibly indicating a theoretical nature of the test instrument. However, it also shows a shift in pre-service teachers' knowledge when entering practical field. Therefore, it can be discussed whether the experiences from practice schools differ from what has been learned at the university courses. For future test developments, the theoretical inclination of the test should be challenged by improving items targeting more of practical knowledge.

Keywords: Teachers' knowledge, general pedagogical knowledge, teacher education.

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1. Introduction

1.1. The nature of general pedagogical knowledge

Teachers' knowledge has an important role in effective teaching (Blomeke & Delaney, 2012; Konig, 2014). Consequently, the teacher education researchers have emphasised the necessity of supporting the development of pre-service and in-service teachers' knowledge base in teacher education programmes. Three components of teachers' knowledge are usually differentiated: content knowledge (the knowledge of the subject), pedagogical content knowledge (the knowledge about teaching and learning a specific subject) and general pedagogical knowledge (GPK) (not linked to subject matter; GPK) (Konig & Pflanzl, 2016; Shulman, 1986). While a large body of empirical studies have been conducted about content knowledge and pedagogical content knowledge, teachers' GPK is still less studied (Konig, Blomeke, Paine, Schmidt & Hsieh, 2011).

According to Shulman (1987), GPK is described as 'broad principles and strategies of classroom management and organisation, knowledge of learners and learning, assessment, educational contexts and educational purposes across different subject domains' (p. 8). However, despite of having the term available for decades, researchers still claim that the term teachers' GPK is still not used similarly in different countries. More specifically, it tends to be influenced by the educational system and cultural perspectives of education (Konig et al., 2011). Nevertheless, there are some main similarities of characteristics when talking about GPK. Taken this into account, in this current study, teachers' GPK is defined as 'the specialised knowledge of teachers in creating and facilitating effective teaching and learning environments for all students, independent of subject matter' (Guerriero, 2017, p. 80).

- 1) An extensive overview of literature (Authors, 2019; submitted) identified six dimensions of teachers' GPK that were most commonly covered in studies about GPK: lesson planning, instructional strategies, classroom management, assessment, general learning processes and student diversity. In the context of current study, also six dimensions were distinguished with only slight differences compared to the literature review:
- 2) *Teaching methods and lesson planning*: structuring learning objectives, lesson, units of curriculum and assessment (Konig et al., 2011), as well as applying difference methods in order to facilitate pupils' understanding of the learning content (Voss, Kunter & Baumert, 2011).
- 3) *Classroom management*: managing several classroom events simultaneously, lesson timing, giving instructions and keeping pupils' attention (Voss et al., 2011).
- 4) *Learning and development*: cognitive learning processes, learning strategies, the role of prior knowledge, memory and information processing etc., (Voss et al., 2011).
- 5) *Affective-motivational disposition*: motivational learning processes, strategies of motivating a pupil or group of pupils (Konig et al., 2011; Voss et al., 2011).
- 6) *Evaluation and diagnosis procedures*: formative and summative assessment, the relationship between assessment and student motivation, quality of assessment (Voss et al., 2011).
- 7) *Data and research literacy*: interpreting, evaluating and using research, in order to enhance teaching and learning.

1.2. Measuring general pedagogical knowledge

Two different approaches have mainly been used when measuring teachers' GPK: (1) perceived level of knowledge and (2) testing of knowledge. In the first case, the participants have been asked to indicate their opinions about their knowledge level in a survey. Contrary to that, testing of knowledge is seen as measuring the level of GPK with a test.

Nevertheless, the attempts to capture teachers' GPK has rather been rare. In 2008, Wong, Chong and Choy (2008) published a study where they used a survey instrument to measure the level of teachers' knowledge. The participants of the study had to indicate their level of knowledge on a 5-point Likert scale (1—no knowledge at all, 2—not so knowledgeable, 3—uncertain, 4—knowledgeable and

5–highly knowledgeable) across five subgroups: facilitation, assessment, management, preparation, and care and concern. Similarly to this, in 2012, Choy, Lim, Chong and Wong (2012) carried out a study where perceptions of knowledge and skills in teaching was developed and validated. Similar to the previously mentioned study, participants had to rate their perceptions on a 5-point Likert scale across these topics: student learning, lesson planning, instructional support, accommodating diversity, classroom management, and care and concern.

However, in the recent years there have been some attempts to measure teachers' knowledge level with a test. These studies are mainly based on teacher education and development study in mathematics (TEDS-M) test that was developed in Germany with a cooperation of teacher educators from the United States and Taiwan (Konig et al., 2011). The test is based on quality, appropriateness, incentive, time model on effective instruction (Slavin, 1994) with a purpose of capturing elements of effective teaching. The test included four main topics: structure, motivation/classroom management, adaptivity and assessment. In later studies, different versions of that test have been used (Blomeke, Jenßen, Grassmann, Dunekacke & Wedekind, 2016; Konig, 2013; Konig, Lammerding, Nold, Rohde, Strauß & Tachtsoglou, 2016; Konig & Rothland, 2012; Lauermaann & Konig, 2016).

1.3. The context of the study: the Estonian pre-service teacher education

Depending on the speciality, the higher education institutes in Estonia offer teacher education both on bachelors' and masters' level. Curricula for special education, pre-school education and primary school teachers are on BA level (3 years). To get a teacher qualification, students have to continue their studies on MA level (2 years). The subject teachers (e.g., mathematics, science, languages), on the other hand, first learn the subject itself at their own faculty on BA level (3 years) and after that they can choose to enter the teacher education studies on MA level (2 years).

For example, in Tartu University, where the current study was carried out, all teacher education programmes include subjects for general pedagogy (24 ECTS), didactics (12–22 ECTS) and school-based internship (24 ECTS). In order to finish the programme and get teacher qualification, the students have to pass a final exam (less often) or write a scientific thesis (more common). Increasing the amount of practice has been one of the main changes in teacher education during the last few years in this university. Now, all teacher education students begin their internship on the first week of their studies, starting with observing lessons. After some time and adjusting to school context, students will have more opportunities to assist teacher and finally prepare and give a lesson autonomously. The specific focus of the internship topic (e.g., pupils' motivation) is in accordance with the theoretical studies at university, allowing students to analyse and reflect on their experiences.

2. Aim and research question

These above mentioned initiatives have given opportunities to measure teachers' GPK; however, this field of study is still rather new and studies that measure teachers' GPK are rare. The current study was carried out as a pilot and therefore the emphasis is on getting more information about the test instrument. As a first step, an analysis based on the statistical parameters of the test items and the uni-dimensional instrument has already been carried out and is reflected in Authors (2019; submitted). Now, the analysis of the instrument is moving on a level of participants' results.

The main aim of the paper is to find out how the pre-service teachers' results in GPK test differed among participants with different characteristics. Based on that, the following research question was addressed: How does pre-service teachers' GPK differ in relation to their internship experience, level of education and work experiences?

3. Method

3.1. Sample

The 135 pre-service teachers studying to be teachers for different age groups of children as well as for different subjects (see Table 1) in Tartu University in Estonia were selected as sample. Most of the pre-service teachers had done their fieldwork (71%). Around 27% had been working as a teacher at least one year. Around 46% of the respondents were studying on MA level and 54% on BA level. The mean age of the respondents was 27 years (min = 18; max = 55).

Table 1. Distribution of participants among curriculum and level of education (missing = 10)

		Level of education					Total
		BA first year	BA second year	BA third year	MA first year	MA second year	
Curriculum	Primary school teachers	0	14	0	1	0	15
	Subject teachers	1	4	3	50	7	65
	Kindergarten teachers	0	21	0	0	0	21
	Special education teachers	21	0	0	0	0	21
	Vocational education teachers	3	0	0	0	0	3
Total	25	39	3	51	7	125	

3.2. Instrument

In order to measure participants' GPK, a Teacher Knowledge Survey (Sonmark, Revai, Gottschalk, Deligiannidi & Burns, 2017) was used. The instrument is adapted from a validated test TEDS-M; however, additional new items were also developed by OECD Secretariat and international experts (Sonmark et al. 2017). All items resulted from an examination of empirical and theoretical evidence in the area of teaching and learning. The development of the instrument is described in more detail in Authors (2019, submitted).

The instrument resulted in three main dimensions of GPK after carrying out an extensive theoretical work: instructional process, learning process and assessment (Sonmark et al., 2017). Each of these main dimensions was broken into two sub-dimensions. All together 60 test items were used during data collection; however, after examining the fit indices of items (Author, Author & Author, 2018; in press), 46 items remained in the following data analysis (Table 2). All items were developed as multiple choice items (respondents had to choose one correct answer) or complex multiple choice items (respondents had to choose a correct answer for several response options covering one question, see Figure 1).

Table 2. The number of items in dimensions and sub-dimensions after removing items with weak indices

Dimensions	Sub-dimensions	No of Items
Instructional process	Teaching methods and lesson planning	12
	Classroom management	3
Learning process	Learning and development	8
	Motivational-affective dispositions	7
Assessment	Evaluation and diagnostics procedures	10
	Data use and research literacy	6

Mrs. Jones, a science teacher, would like to apply formative assessment in her course. Which of the following

strategies are best suited for this type of assessment? Check one box in each row.		
	Suited	Not suited
(a) She plans to assess pupils at the end of the term, based on a test results.	<input type="radio"/>	<input type="radio"/>
(b) She plans to provide pupils qualitative feedback at several time points during the term.	<input type="radio"/>	<input type="radio"/>
(c) She plans to accommodate activities based on pupils' progress rather than follow a fixed plan.	<input type="radio"/>	<input type="radio"/>
(d) She plans to compare pupils' results against a set standard.	<input type="radio"/>	<input type="radio"/>

Figure 1. An example of complex multiple choice item (assessment dimension, evaluation and diagnosis procedures sub-dimension)

3.3. Procedure

The process of data collection included reviewing and improving the survey instrument together with an expert groups, followed by translation process (from English to Estonian). Data were collected with an electronic survey on FluidSurvey environment. The pre-service teachers filled in the survey on the spot during one of their teacher education courses. The ones who were on their last year of studies received survey via e-mail.

All participants had exactly 60 minutes to fill in the initial knowledge test with 60 questions. The test had to be filled in with one go as there was no option to pause it and continue later. The survey part with background questions was not timed.

3.4. Data analysis

For data analysis an item response theory (IRT), one-parameter (1PL) model was used. The analysis was carried out using Winsteps Rasch (Version 4.0.0) software. The 1PL model gives an opportunity to create achievement scores for every respondent, while placing the respondents' abilities on a same scale with the difficulty level of items. The IRT person measures were calculated for every participant. Due to non-parametrical nature of the data, Mann–Whitney U test and Kruskal–Wallis test were used

in order to compare participants mean measures of GPK. In addition to that, linear regression analysis was carried out.

4. Results

An interesting phenomenon appeared when comparing pre-service teachers' knowledge level among their internship experiences. The results show that the pre-service teachers who have not done their internship yet, possess more GPK than the ones with this experience ($p = 0.011$; Table 3). When looking at the level of education, the highest scores of knowledge was achieved by masters' level students ($p = 0.000$; Table 3). Bachelors' second and third year, however, presented a lower level of knowledge than bachelors' first year students.

Table 3. Pre-service teachers' knowledge differences across internship experience and level of education

	<i>N</i>	Mean rank	<i>p</i>
No internship experience	30	81.50	
1-6 months internship experience	51	71.28	
More than 6 months internship experience	53	55.93	
		<i>Kruskal-Wallis test</i>	0.011*
BA 1st year	27	65.41	
BA 2nd and 3rd year	42	44.83	
MA 1st and 2nd year	58	77.22	
		<i>Kruskal-Wallis test</i>	0.000*

* $p < 0.05$.

The pre-service teachers were also asked about their work experiences. The results showed that there is no difference in terms of GPK level across pre-service teachers who have or does not have teaching work experience ($p = 0.134$; Table 4). Interestingly, these pre-service teachers who had some other educational work experience also possess more GPK ($p = 0.045$; Table 4).

Table 4. Pre-service teachers' knowledge differences across work experiences

	<i>N</i>	Mean rank	Mann-Whitney U	<i>p</i>
No teaching work experience	98	64.45		
Yes, been working as a teacher	36	75.79		
			1465.5	0.134
Doesn't have additional educational work experience	74	61.89		
Has additional educational work experience	61	75.42		
			1804.5	0.045*

* $p < 0.05$.

Next, a regression analysis was carried out in order to verify the predictive relationship between knowledge level and pre-service teachers' background characteristics (Table 5). The regression model explained 14% of the variance ($R^2 = 0.14$, $F(4.83) = 4$, $p < 0.01$). The results indicated that the characteristics predicting GPK test results were internship experience ($\beta = -0.211$; $p < 0.05$) and level of education ($\beta = 0.183$; $p < 0.5$). Therefore, when looking at all these factors together in a regression model, the additional educational work experience does not show significant prediction as was suggested by the comparison tests.

Table 5. Regression model. The variable and scale descriptions are presented in Appendix A

	B	β	p
Constant (mean measure of GPK)	0.282		0.335
Internship experience	-0.215	-0.211	0.015*
Teaching work experience	0.165	0.092	0.290
Level of education	0.181	0.183	0.035*
Additional educational work experience	0.241	0.156	0.073
R ² = 0.14			

*p < 0.05.

As a result of the previous data analysis, the IRT mean measures of the subgroups' GPK test results are presented in Figure 2. It is apparent that the 1st year BA student who already has some internship experience also has more GPK. However, on the 2nd and 3rd year of BA, the opposite situation appears. Same pattern but higher results remains on MA level. It is also important to parallel these results with the description of sample in terms of their curricula. 1st year BA students are almost all studying to be special education teachers ($n = 21$), and the 2nd and 3rd year BA students were mostly kindergarten ($n = 21$) and primary school teachers ($n = 14$). MA level respondents were studying to be subject teachers in K-12 schools ($n = 57$). As stated in the theoretical part of the article, the subject teachers enter teacher education studies on MA level; therefore, they do not have previous learning experience in teaching field.

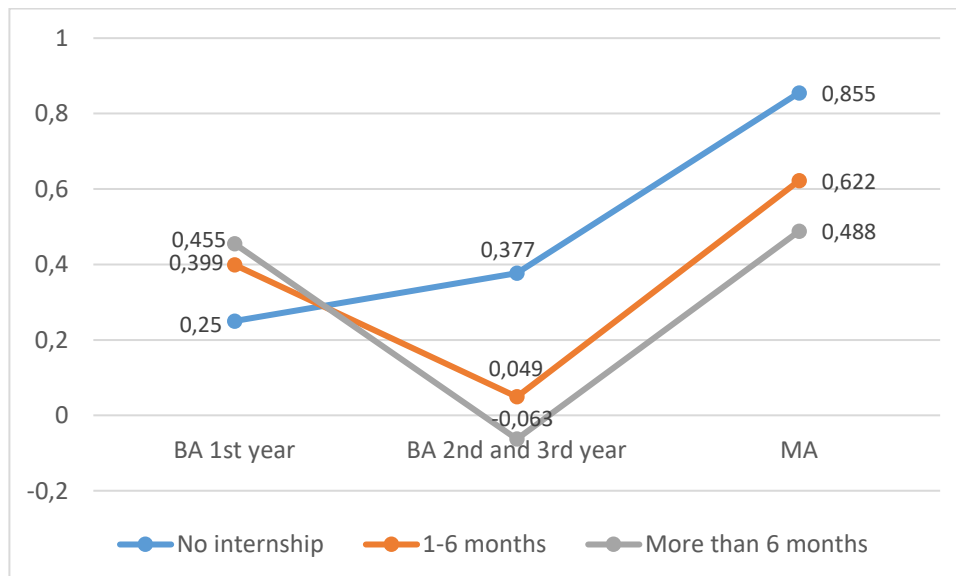


Figure 2. Participants mean measure of GPK test across their internship experience and level of education.

5. Discussion

A comparison of respondents with different characteristics was carried out in order to get more information about the test instrument. The results refer to the theoretical nature of the test instrument as it was easier for respondents who had no internship experience yet. However, the theoretical background of the test presents GPK that is used to create and facilitate effective learning environment (Sonmark et al., 2017), showing a clear connection to the practical use of the knowledge. If the test is difficult for respondents with more teaching experiences, it might not have captured the knowledge it was aimed for.

The more the pre-service teachers advance in their curriculum, their time spent at internship placement grows. By the second semester of third year of BA, most of the theoretical university courses are usually done. At this point, main attention is on internship and writing thesis. Shifting away from theoretical work may also explain why pre-service teachers with internship experience possess less GPK.

However, the results also show a shift in pre-service teachers' knowledge when they enter the practical field. It can be discussed whether the experiences from practice schools differ from what has been learned at the university courses, or is this issue connected to the reorganisation of knowledge when starting a teaching profession (Berliner, 2001). When facing real life situations in teaching, the formal knowledge of teaching shifts to knowing how to teach (Feiman-Nemser, 2001). This finding is supported by longitudinal empirical study (Konig, Blomeke, Klein, Suhl, Busse & Kaiser, 2014), showing that GPK gain continues after entering the teaching profession; however, the teacher education programmes should keep supporting the knowledge acquisition while entering the practical field.

In addition to this, better knowledge was presented by masters' students who are mainly subject teachers entering teacher education studies on masters' level. A question can be raised if these students are more experienced in learning theoretical knowledge, compared to bachelors' students. This, again, is an indication to the theoretical nature of the test instrument.

For future GPK test developments, the theoretical inclination of the test should be challenged by including more situation based questions that combine both, theoretical and practical knowledge. However, these concepts should have strong empirical evidence as well as practical implications to teachers' everyday work. One option for this is connecting the questions' content more with the knowledge that teachers actually use in their everyday practice. Also the structure of questions could be improved in order to support the idea of practical implications. For that, open-ended questions or video analysis can be used. For example, Konig et al. (2011) used open-response questions when measuring teachers' GPK. The task was built in a way that based on situation description, the respondents had to give supportive feedback and evaluate another future teacher. The aim for these questions was to get indication about the respondents' competence for analysing and reflecting on lesson practices. Another approach that has been used in investigating GPK is video-vignette assessment, where the participants had to notice and interpret classroom situations (Konig et al., 2014). The study showed the complexity of connecting theoretical knowledge with practical skills. However, it should be taken into account that open-ended questions in a large-scale study can be very time-consuming because of complicated qualitative data analysis process.

As one of the limitations, the current study was carried out as a pilot study which brings to a rather modest and uneven size of the sample groups. Also, the results are merely based on one research site; however, the international capability of the test instrument could be addressed in the future. The results and discussion of the study raise points for future test development. Most importantly, the nature of GPK and how to address it when measuring should be further investigated in order to achieve better connection to teachers' everyday practice.

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Appendix A Variable and scale descriptions of the regression model

Variable	Scale
Internship experience	1—none 2—1–6 months 3—6 months or more
Teaching work experience	0—no 1—yes
Level of education	1—BA first year 2—BA second and third year 3—MA
Additional work experience in other disciplines	0—no 1—yes
Additional educational work experience	0—no 1—yes