

Is the source for my curriculum knowledge and other competencies the same? Evidence from PISA 2015

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Abstract

This study aims to examine to what extent the field of competence regarding curriculum knowledge is concordant with the other sub-competency fields of teaching. These fields are field knowledge, pedagogic competence in field teaching, use of information and communication technologies in teaching, student behaviours and class management, individualised learning approaches, teaching students with special needs, education in a multicultural and multilingual environment, teaching cross-curricular skills, vocational guidance, internal evaluation of schools and self-evaluation, teacher–parent collaboration and school management and administration. Survey is our research model. The participations of the study are 54.395 teachers from 17 different countries, which have been obtained from PISA 2015. The correspondence and multiple correspondence analyses were used. The results of simple correspondence analysis have revealed that the measure of accountable correspondence is more than 50% between the sources of curriculum knowledge and those of other sub-competency fields such as field insight and knowledge, pedagogic competence in field teaching and student assessment procedures. Likewise, multiple correspondence analysis has also produced similar results.

Keywords: Teacher training, curriculum knowledge, curriculum development, correspondence analysis.

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1. Introduction

The teaching profession encompasses many skills and competence fields and requires specialised expertise. One of these competencies is awareness about curriculum and curriculum development. Teachers' and teacher candidates' knowledge and awareness about curriculum may be considered as one of the essential fields of competence for the profession of teaching. Teachers' levels of knowledge in this field of competence are highly coherent with what they know about the other fields of competence pertinent to teaching (field knowledge, field teaching, assessment and evaluation, class management, etc.). In this scope, equipping both teachers and teacher candidates with skills of curriculum literacy may also contribute significantly to their teaching skills. Teachers both partake in the curriculum development process and apply the curriculum in their classes. If the teacher who is primarily responsible for the execution of the program in the classroom has poor skills, then the program itself becomes questionable regardless of the quality level (Güven, 2004). Likewise, the Ministry of National Education (MNE) also defined this skill area (curriculum literacy) among teacher competencies in 2006, which clearly underlines its significance.

One might state that efforts to outline teacher competencies started around 1999 in Turkey. Following this initiative, studies and study groups were organised and conducted to determine teacher competencies together with the Support Program for Primary Education. As part of this program and project, 6 main and 31 sub-competency fields have been determined through the efforts by CHE-MNE, General Directorate of Teacher Training and Education and Training Research and Development Department (MNE, 2017). Those main fields of competence include personal and professional values, getting to know students, learning and teaching processes, monitoring and evaluating learning and development, relations among family, school, and community and knowledge about curriculum and content. Then, all have been put into practice in 2006. As one can easily see, curriculum knowledge has been listed among those six main fields of competence. Sub-competency fields relevant to this primary field, on the other hand, are goals and principles of Turkish national education, knowledge about the curriculum for a specific field, know-how skills and monitoring and evaluating the curriculum for a specific field. Although curriculum knowledge is included within teacher competencies together with other fields of competence, this has not been reflected in teacher training programs, and not every teacher training program offers courses about this competence. A closer examination of teacher training programs applied at faculties of education has revealed that there is a limited number of relevant courses incorporated into teacher training programs, which are 'curriculum development' in social studies education, 'science technology program and planning' in science education and 'preparation for primary education and primary education programs' in preschool education. Concerning other teacher training programs, some universities provide few elective courses about curriculum development and curriculum knowledge, and some others neglect such courses.

Teacher competencies have been updated in 2017 under the light of 'recent insights in the field of education' (MNE, 2017). Accordingly, teacher competencies in different countries have been inspected, and general fields of competence for teaching profession have been outlined through broad participation. These fields include professional knowledge, professional skills, attitudes and values. In line with these general fields of competence, 11 other sub-competency fields have also been formulated. A review of all fields indicates that there is no distinct field of competence for curriculum knowledge/curriculum development. There is only one statement, 'has a good knowledge of curriculum in his/her field,' inserted into sub-competency field of knowledge about field education, which branches out from the general field of competence for professional knowledge.

Similarly, constant changes have been made on teacher training programs since the beginning of 2018–2019 academic year. During this process of improvement, several amendments have been made on the programs based on the general fields of competence for teaching profession determined by the MNE and other stakeholders. One of these changes regards the inclusion of a course about 'field

specific curriculum' into primary and secondary school teacher training programs. Table 1 summarises different names and categorical classification of this course across various teacher training programs.

Table 1. The course 'field-specific curriculum' and its categorical classification

Teacher training program	Course name	Course category
Pre-school Education	Pre-school curriculum	Field-specific
Primary School Education	--	--
Social Studies Education	Social studies curriculum	Field specific
Science Education	Science curriculum	Field specific
Primary School of Math. Educ.	Secondary School of Mathematics curriculum	Field-specific
Turkish Language Teaching	Turkish language curriculum	Field-specific
English Language Teaching	English language curriculum	Field-specific
Chemistry Education	Chemistry curriculum	Field-specific
Computer Education & Educational Technology	Information curriculum	Field-specific
Physics Education	Physics curriculum	Field-specific

As clearly shown in Table 1, all teaching departments offer a course aiming to analyse the field-specific curriculum except for the primary school education department. With regards to primary education, relevant examination of each course's curriculum (social studies, mathematics, Turkish, etc.) is integrated into each course such as Turkish language teaching and social studies teaching (YOK, 2018). All courses about curriculum are categorised as field-specific courses. On the whole, inclusion of such courses into new teacher training program can be noted as an effort to establish a unity across teaching skills these programs try to improve, and this can be deemed as a positive sign indicating that teacher candidates can become aware of such concerns during undergraduate years and they can train themselves in advance.

When the focus is directed to European Union countries, a privilege Turkey has been working to earn a wide variety that is easily discernible across teacher training systems and programs (Aykaç, Kabaran & Bilgin, 2014). In countries where the state system is adopted, such as Germany, not only obligatory regulations but also the system and teacher training programs vary across different states. Besides, teacher training systems for both primary and secondary education institutions are planned either simultaneously (theory and practice hand in hand) or consecutively (first theory and then practice) (Ozer & Alkan, 2017). Regardless of the format, a certain percentage of the total credits across teacher training programs for all levels and fields is dedicated to courses on professional skills for teaching. For instance, 42 of 180 ECTS credits are spared for courses on educational sciences at the secondary education of mathematics teacher training programs in Nordrhein-Westfalen, Germany. Furthermore, the master's program built on top of this allocates a total of 400 hours to practice and requires students to design a project based on their field-specific knowledge (Baki & Baki, 2016).

In England, teacher training programs are within the responsibility limits of universities, colleges and educational high schools. Training duration ranges from 3 to 4 years (Aykaç et al., 2014). Providing undergraduate education, universities mostly offer courses in various modules. For example, primary education teacher candidates are granted with Qualified Teacher Status—a license valid throughout all the country—upon completing their 3-year education at the Faculty of Education, Greenwich University (University of Greenwich, 2018). A closer look at the program unravels that courses on curriculum development are also integrated in the general curriculum, and there are even two complementary courses in the training program: 1. Engaging with the more comprehensive curriculum=Understanding the world – 2. Engaging with the broader curriculum=Expressing and communicating ideas. Another similar example from England can be given from Canterbury Christ Church University's Faculty of Education. Similarly, this faculty's primary education teacher training undergraduate program also involves courses on curriculum development. Students must complete credits for three courses across three years: 'exploring curricula and pedagogy' first year, 'subjects

within curriculum' second year and 'curriculum innovation' third year (Canterbury Christ Church University, 2018).

Likewise, the teacher training programs at Leeds University (2019) offer two courses on curriculum development, which are 'International perspectives of pedagogy and practice' and 'Educational policy and politics'. Moreover, one of the undergraduate courses that have to be taken by both on-campus and distance education students at the faculty of education of Simon Fraser University in Canada is 'Curriculum development: Theory and practice'. Graduate and vocational development programs of the same university mandate that students take another course with a similar syllabus (Simon Fraser University, 2019). Science education teacher training undergraduate program at Hong Kong University Faculty of education is no different in this sense. In this program, 120 of all the credits (300) are spared for courses on educational sciences (Hong Kong University Education Faculty, 2019). 'Curriculum and assessment' course with six credits, among others, is obligatory for biology, chemistry and physics fields separately, and the goal is to improve students' skills and competence to develop school-centred curriculum through analysing other similar curricula. Of course, the list of examples can be made longer, and this alone points out the significance of raising teachers fully equipped with curriculum knowledge. One of the suggestions is to endow teacher candidates with relevant experience through the use of instructional program materials during the teacher training process (Davis, Palincsar, Smith, Arias & Kademian, 2017; Drake, Land & Tyminski, 2014).

Approximately 54.000 teachers from 17 different countries who took the PISA exam in 2015 stated that they had taken at least one course on 'curriculum development' either during their undergraduate years or as part of their in-service training (PISA, 2015). Although the presence of a course on 'curriculum development' during pre-service years of teacher candidates fills one of the significant fields of competence in teacher training, it is, of course, not enough on its own to build professional competence. Through a theoretical framework, it is highly probable that this field of competence is in close relation, harmony and integrity with other fields of competence (Gamarli & Abdulleyeva, 2017). Pedagogic competence in field teaching, student assessment procedures, use of information and communication technologies in teaching, student behaviours and class management, individualised learning approaches, teaching students with special needs, vocational guidance and teacher-parent collaboration can be taken as examples of competence fields that complete, co-exist and form a unity with the field of curriculum knowledge. When the literature is reviewed, the studies addressing the significance of curriculum development in teacher training programs (Addisu & Wudu, 2019; Akyildiz, Altun, Kasim & 2018; Alsubaie, 2016; Dincer & Kapisiz, 2013; Korkmaz & Altindag, 2017), and a study addressing determination of how pedagogical formation shows compatibility with the other fields has not been encountered. Thus, this study aims to determine the highest level of harmony that field of curriculum knowledge has with other sub-competency fields. Accordingly, answers have been sought for the following research questions:

1. To which of their other professional resources do teachers' curriculum knowledge resources highly correspond?
2. What is the nature of correspondence when all variables regarding sources of various competencies are considered as a whole?

2. Method

2.1. Research model

With a quantitative design, this study aims to analyse the correspondence between the sources of curriculum knowledge and sources of other professional skills. Therefore, this research adopts a correlational survey model. This model aims to determine concurrent cases of variables and how this occurs in this phenomenon (Kumandas Ozturk, 2019). In this study, the correspondence between teachers' sources of curriculum knowledge and other fields of professional competence has been examined. The correspondence (Greenacre and Hastie, 1987) and multiple correspondence analyses

(Alpar, 2013) define the relationship between the distributions of lines and columns of variables. In this study, as compatibilities of both variables are reviewed both individually and concurrently, this model and analyses have been preferred.

2.2. Participants

This study is based on the data set provided by 54.395 teachers from 17 countries or regions taking part in PISA 2015, and the distribution of participants is shown in Table 2.

Table 2. Distribution of participants across countries

Country	f	%	Country	f	%
Australia	7,369	13.5	Germany	3,560	6.5
Brazil	5,354	9.8	Hong Kong	1,841	3.4
Chile	2,382	4.4	Korea	2,130	3.9
China-Taipe (Taiwan)	3,130	5.8	Peru	2,919	5.4
China-Makau	2,410	4.4	Portugal	2,255	4.1
China (Bejing-Shanghai-Jiangsu-Guangdong)	3,879	7.1	Spain	2,517	4.6
Columbia	3,282	6.0	United Arab Emirates	4,475	8.2
Czech	3,751	6.9	United States of America	2,097	3.9
Dominican Republic	1,044	1.9	Total	54,395	100

The recipients of PISA studies are teenagers at the age of 15. The inclusion of teachers in this study group is unveiled and justified in the relevant report (OECD, 2017). According to this report, only those teachers working at the schools that students who partook in PISA 2015 attended have been chosen as participants. The criterion, 'Working as a teacher at these schools', was set in three different formats, which are 'working there in the past', 'working there currently' and 'will be working there in a year'. Yet, no connection has been set between teachers and students. Likewise, teachers affiliated with those schools have also been classified as 'science teachers' and 'non-science teachers' with an equal number of participants in each.

2.3. Data collection instruments

'Teacher Questionnaires for PISA 2015' has been conducted to the teachers of the students participating in the PISA 2015 study. In this survey, the questions in the fields of 'Background information', 'Your initial education (IE) and professional development (PD)', 'Your school' and 'Science teaching practices' have been asked. A general question of 'Were any of the topics listed below included in your teacher education or training program or other professional qualification and your PD activities?' has been asked to the teachers in 'Your IE and PD' section. This general question has been queried whether or not they have adopted their competencies in the fields of 'knowledge and understanding of my subject field(s)', 'pedagogical competencies in teaching my subject field(s)', 'knowledge of the curriculum', 'student assessment practices', 'information and communication technology (ICT) skills for teaching', 'student behaviour and classroom management', 'school management and administration', 'knowledge and understanding of my subject field(s)', 'teaching students with special needs', 'approaches to individualised learning', 'teaching in a multicultural or multilingual setting', 'teaching cross-curricular skills (e.g., problem-solving, learning-to-learn)', 'student career guidance and counselling', 'internal evaluation or self-evaluation of schools', 'use of evaluation results' and 'teacher-parent co-operation' with 'IE' or 'educational development'. These two options reveal four different cases such as 'not existing', 'only part of IE', 'only part of PD' and 'overlap IE and PD'.

2.4. Data analysis

The analyses have been conducted with the data of the teachers fully completing the questions relating to the study subject and participating in PISA 2015 study. These data are categorically variable. Preliminary analyses such as validity, reliability or modelling for the analyses conducted in relation to these variables have not been needed but have been conducted over directly categorical data.

This study focuses on the correspondence between teachers' sources of curriculum knowledge and other fields of professional competence. Accordingly, the relation between the sources of each professional competence variable and the source of curriculum knowledge has been analysed through correspondence analysis. During this analysis, the admissibility of the model was tested and questioned. Subsequently, the total inertia value was calculated to interpret the significance of the model. Since there is no agreement as to the threshold of this value within literature (Lam, 2016), only those relations producing a value higher than 50% have been taken into account. In correspondence analysis, the number of dimensions/aspects in a model has been determined by $(n - 1)$ number of variable categories. Glynn's (2014) ideas guided the examination of contributions made by the dimensions of the model. According to Glynn (2014), the contribution to the dimensions should be at least 75%. In line with this understanding, examination of a dimension has been discontinued when total contribution either reached or exceeded 75%. In the next step, variables' relative contributions to horizontal and vertical dimensions have been analysed. Variables' options have been considered for the contribution of each dimension. Because the variables in this study form four different categories, any variable contributing more than 25% ($100/4 = 25$) has been deemed significant. Likewise, the multiple-correspondence analysis was employed to figure out the correspondence among all the variables. As for this analysis, on the other hand, Comrey and Lee's (1992) argument was adopted, and those with either 0.70 or higher loads have been interpreted.

3. Findings

Firstly, the significance of distributions concerning curriculum knowledge and other fields of professional competence were studied, and relevant results are shown in Table 3.

Table 3. The significance of distributions concerning knowledge of the curriculum and other fields of competence

Variables	Dimensions	Single Value	Inertia	χ^2	Inertia Rate	
					Calculated	Total
Knowledge of the curriculum – knowledge and understanding of my subject field(s)	1	0.61	0.37	35,371.44*	0.57	0.57
	2	0.41	0.17		0.26	0.83
	3	0.33	0.11		0.17	1.00
	Total		0.65		1.00	1.00
Knowledge of the curriculum – pedagogical competencies in teaching my subject field(s),	1	0.61	0.37	38,352.65*	0.53	0.53
	2	0.44	0.19		0.27	0.80
	3	0.38	0.14		0.20	1.00
	Total		0.71		1.00	1.00
Knowledge of the curriculum – student assessment practices	1	0.60	0.36	41,315.39*	0.48	0.48
	2	0.47	0.22		0.29	0.76
	3	0.42	0.18		0.24	1.00
	Total		0.76		1.00	1.00
Knowledge of the curriculum– ICT skills for teaching,	1	0.43	0.19	16,927.19*	0.59	0.59
	2	0.26	0.07		0.22	0.81
	3	0.24	0.06		0.19	1.00
	Total		0.31		1.00	1.00

Knowledge of the curriculum – student behaviour and classroom management,	1	0.48	0.23		0.52	0.52
	2	0.35	0.12		0.28	0.79
	3	0.31	0.09		0.21	1.00
	Total		0.45	24,395.96*	1.00	1.00
Knowledge of the curriculum – School Management and Administration	1	0.29	0.09		0.49	0.49
	2	0.24	0.06		0.33	0.83
	3	0.17	0.03		0.17	1.00
	Total		0.17	9,499.14*	1.00	1.00
Knowledge of the curriculum – approaches to individualised learning	1	0.44	0.20		0.53	0.53
	2	0.33	0.11		0.28	0.81
	3	0.27	0.07		0.19	1.00
	Total		0.38	2,045.33	1.00	1.00
Knowledge of the curriculum – Teaching Students with Special Needs	1	0.33	0.11		0.58	0.58
	2	0.21	0.05		0.25	0.83
	3	0.17	0.03		0.17	1.00
	Total		0.18	9,912.93*	1.00	1.00
Curriculum Knowledge-teaching in a multicultural or multilingual setting	1	0.29	0.09		0.52	0.52
	2	0.23	0.05		0.31	0.84
	3	0.16	0.03		0.16	1.00
	Total		0.16	8,942.62*	1.00	1.00
Knowledge of the curriculum – Teaching Cross-Curricular Skills	1	0.437	0.191		0.539	0.539
	2	0.300	0.090		0.254	0.793
	3	0.271	0.074		0.207	1.000
	Total		0.35	19,283.89*	1.000	1.000
Knowledge of the curriculum – student career guidance and counselling,	1	0.34	0.12		0.56	0.56
	2	0.23	0.05		0.27	0.83
	3	0.19	0.03		0.17	1.00
	Total		0.21	11,155.56*	1.00	1.00
Knowledge of the curriculum – internal evaluation or self-evaluation of schools	1	0.40	0.16		0.56	0.56
	2	0.26	0.07		0.25	0.81
	3	0.23	0.05		0.19	1.00
	Total		0.28	15,302.98*	1.00	1.00
Knowledge of the curriculum – use of evaluation results	1	0.41	0.17		0.57	0.57
	2	0.27	0.07		0.24	0.81
	3	0.24	0.06		0.19	1.00
	Total		0.30	16,292.41*	1.00	1.00
Knowledge of the curriculum – teacher–parent co-operation	1	0.40	0.16		0.57	0.57
	2	0.25	0.06		0.22	0.79
	3	0.24	0.06		0.21	1.00
	Total		0.28	15,277.43*	1.00	1.00

* $p < 0.05$

As displayed in Table 3, there is a significant relationship between the sources of knowledge of the curriculum and the sources of other fields of professional competence. The accountable correspondence is higher than 50% between knowledge of the curriculum and knowledge and understanding of my subject field(s), pedagogical competencies in teaching my subject field(s) and student assessment practices. This research focuses on correspondence that can be accounted for more than 50%. The contributions of these correspondences to the dimensions have been depicted via their graphical distributions. Across all analyses, it has been closely monitored if the contributions of dimensions to the explanation were either 75% or more. Because the number of dimensions to be

formulated during correspondence analysis is determined by $(n - 1)$ number of variable categories, three dimensions $(n - 1 = 4 - 1=3)$ have been formulated for this research. Regarding the correspondence level that can be accounted for either 50% or more, there were only two dimensions, so this research has focused on the two. As for contributions to dimensions, only 0.25 or higher were included in the analyses.

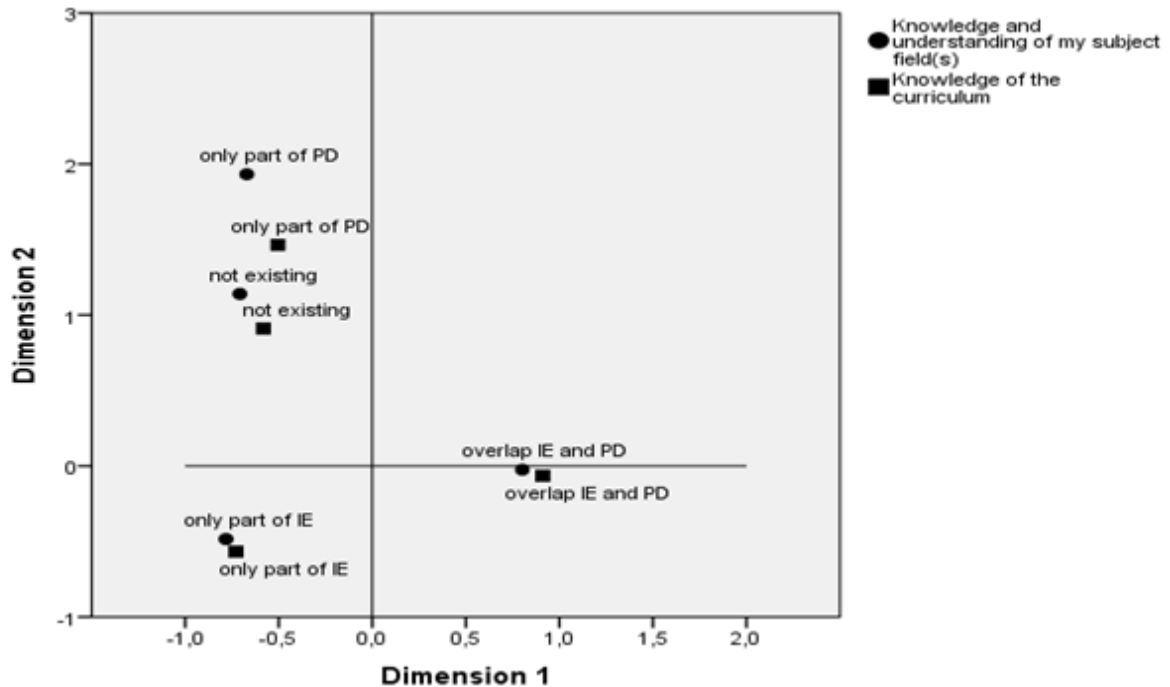


Figure 1. Distribution of the sources for knowledge of the curriculum and knowledge and understanding of my subject field(s)

Table 4. Dimensional loads of the distribution of the sources for knowledge of the curriculum and knowledge and understanding of my subject field(s)

Options	Knowledge of the curriculum		Knowledge and understanding of my subject field(s)	
	1	2	1	2
Not existing	0.07	0.24	0.056	0.217
Only part of IE	0.32	0.29	0.385	0.219
Only part of PD	0.04	0.46	0.046	0.563
Overlap IE and PD	0.57	0.00	0.513	0.001

As can be seen in Figure 1, all variables have a close distribution. Especially, 'only part of IE' and 'only part of PD' exhibit a very similar format. With respect to contribution to dimensions, the option 'overlap IE and PD' mainly adds on to the first dimension, and the option 'only part of PD' contributes to only the second dimension as regards knowledge and understanding of my subject field(s). Moreover, they are also distant in Figure 1.

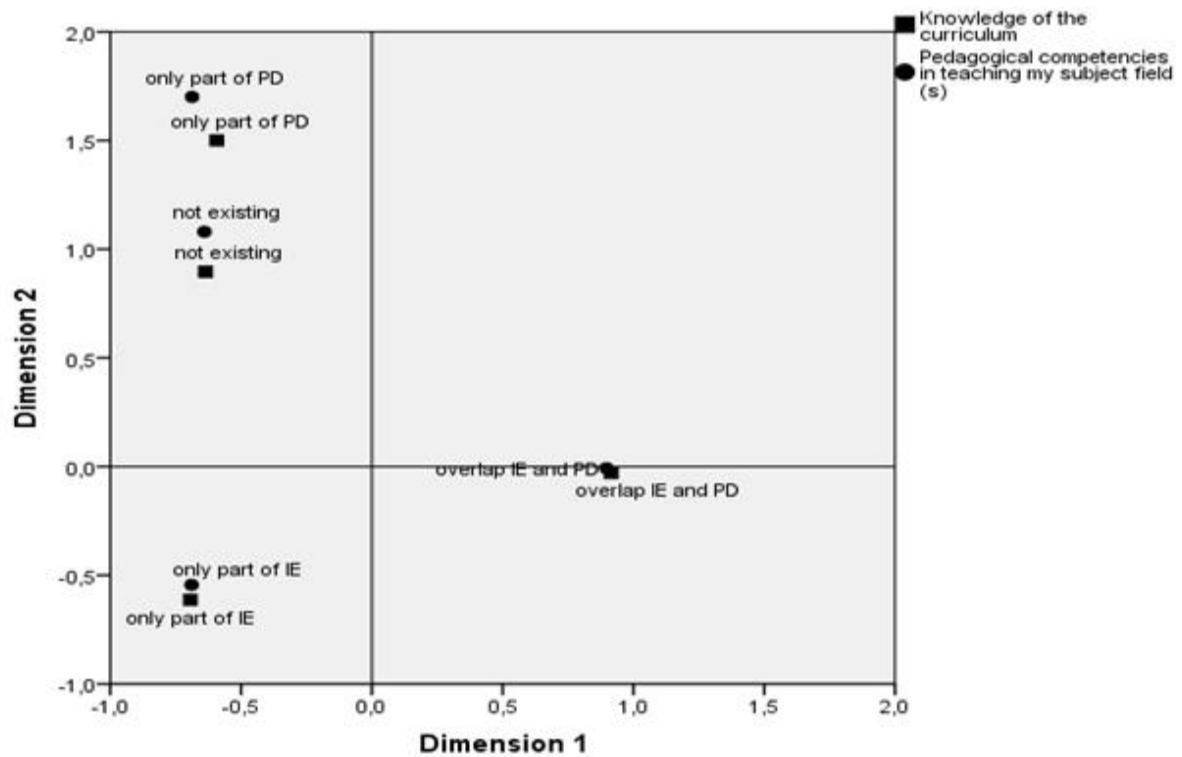


Figure 2. Distribution of the sources for knowledge of the curriculum and pedagogical competencies in teaching my subject field(s)

Table 5. Dimensional loads of the distribution of the sources for curriculum knowledge and pedagogic competencies in field teaching

Options	Knowledge of the curriculum		Pedagogical competencies in teaching my subject field(s),	
	Dimensional Loads		Dimensional Loads	
	1	2	1	2
Not existing	0.08	0.22	0.06	0.25
Only part of IE	0.29	0.32	0.31	0.27
Only part of PD	0.05	0.46	0.06	0.47
Overlap IE and PD	0.58	0.00	0.57	0.00

Figure 2 exhibits a distribution similar to the one above. Again, all variables have a close distribution. Notably, the options 'only part of IE' and 'overlap IE and PD' display a very close distribution. With respect to contribution to dimensions, 'Overlap IE and PD' primarily accumulates around the first dimension, and 'Not existing' contributes significantly to only the second dimension as regards pedagogic competencies in field teaching. In addition, they are also graphically distant. On the other hand, the option 'Only part of PD' significantly enhances only the second dimension. However, it is also distant in the figure.

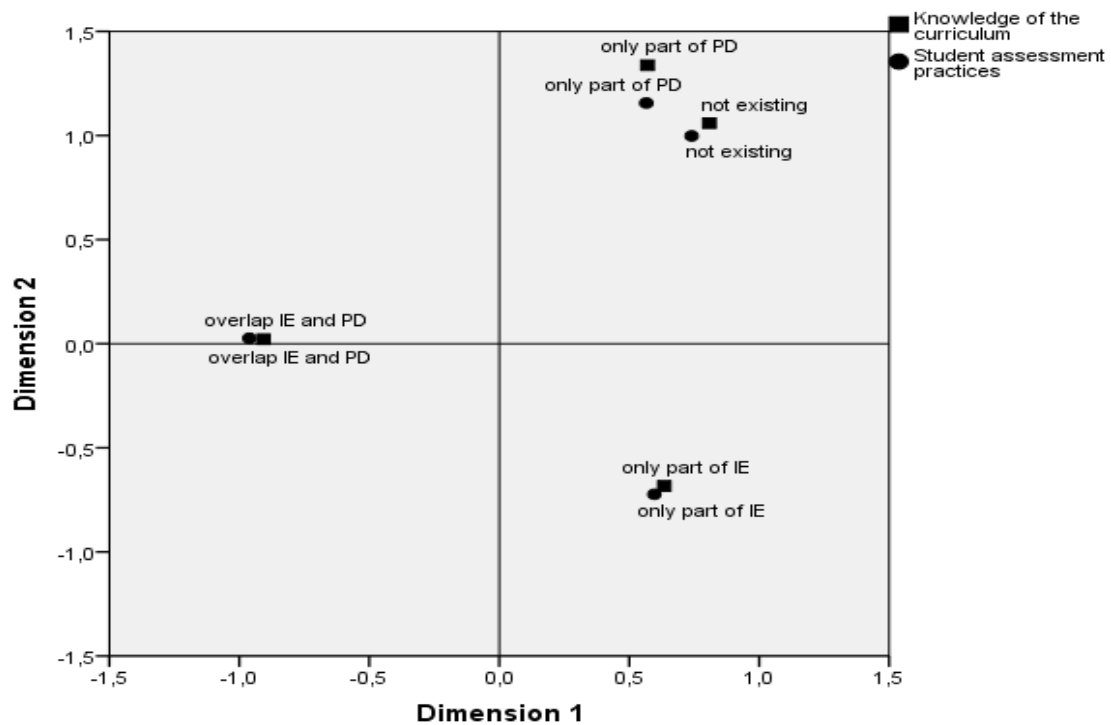


Figure 3. Dimensional loads of the distribution of the sources for knowledge of the curriculum and student assessment practices

Table 6. Dimensional loads of the distribution of the sources for curriculum knowledge and student assessment practices

Options	Knowledge of the curriculum		Student assessment practices	
	Dimensional Loads		Dimensional Loads	
	1	2	1	2
Not existing	0.13	0.29	0.12	0.29
Only part of IE	0.25	0.37	0.22	0.41
Only part of PD	0.05	0.34	0.05	0.29
Overlap IE and PD	0.58	0.00	0.60	0.00

In this distribution, all options except for ‘overlap IE and PD’ significantly contribute to the second dimension. The third option enhances only the first dimension. Likewise, the option ‘only part of IE’ also contributes to the first dimension as regards knowledge of the curriculum. On the other hand, a closer look in Figure 3 indicates that the best correspondence is between ‘only part of IE’ and ‘overlap IE and PD’.

A multiple-correspondence analysis was also carried out to see the overall distribution of the sources for all competencies. The results have revealed that sources mainly gather around two dimensions. Multiple-correspondence analysis can be deemed as a structuring factor analysis for categorical variables. Findings point out that factor means range between 0.27 and 0.63. Regarding the values of factor loads, the value for the first dimension is higher than that of the second one.

Furthermore, variables having factor loads higher than 0.70 are pedagogical competencies in teaching my subject field(s), student assessment practices, knowledge of the curriculum, and knowledge and understanding of my subject field(s). These variables are the ones with the highest correspondence with knowledge of the curriculum in simple correspondence analysis. The same result can also be observed in Figure 4.

Table 7. Dimensional loads in multiple-correspondence analysis

Variables	Dimensions		Mean
	1	2	
Pedagogical competencies in teaching my subject field(s)	0.77	0.50	0.63
Student assessment practices	0.76	0.59	0.67
Knowledge of the curriculum	0.75	0.51	0.63
Pedagogical competencies in teaching my subject field(s)	0.75	0.46	0.61
Student behaviour and classroom management	0.65	0.56	0.60
Teaching Cross-Curricular Skills	0.58	0.50	0.54
Approaches to individualised learning	0.55	0.49	0.52
Teacher-parent co-operation	0.54	0.50	0.52
Use of evaluation results	0.53	0.47	0.50
ICT skills for teaching	0.52	0.41	0.47
Internal evaluation or self-evaluation of schools	0.49	0.46	0.47
Student career guidance and counselling	0.39	0.32	0.35
Teaching Students with Special Needs	0.35	0.33	0.34
Teaching in a multicultural or multilingual setting	0.28	0.25	0.27
School Management and Administration	0.27	0.26	0.27
Total	8.18	6.62	7.40

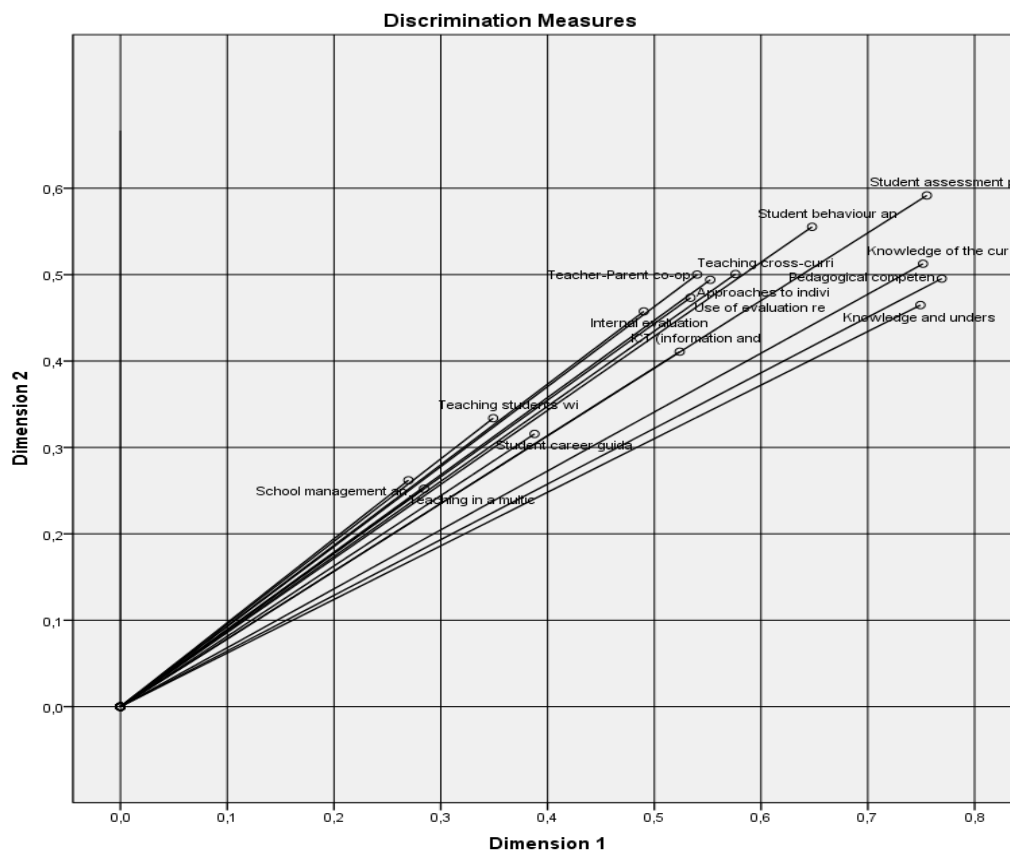


Figure 4. Dimensional distribution graphic

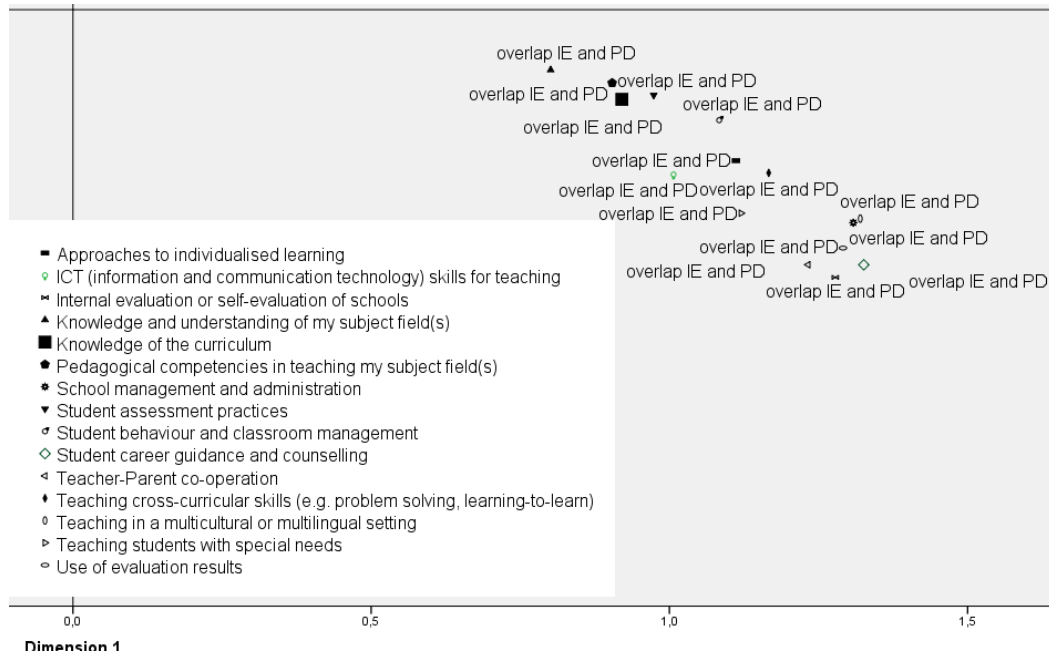


Figure 5. Multiple distributions of sources for professional competencies according to the variable 'Overlap IE and PD'

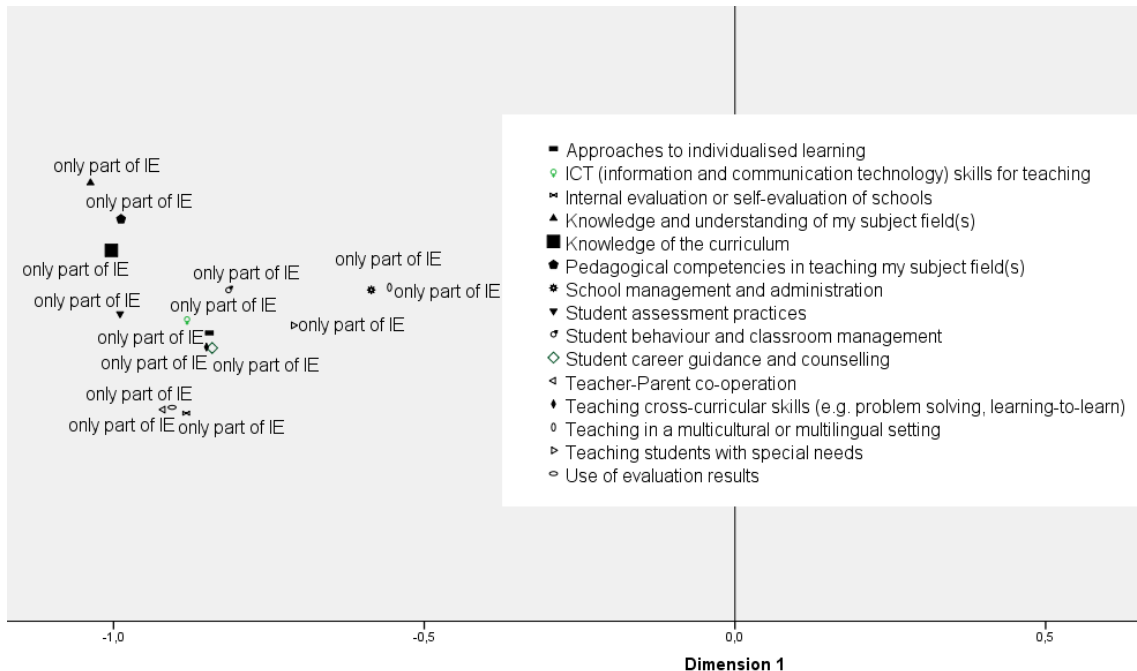


Figure 6. Multiple distributions of sources for professional competencies according to the variable 'only part of IE'

Graphical results (depicted as Figures 5 and 6 to provide details) concerning multiple distributions of sources for knowledge of the curriculum and professional competencies have produced similar outcomes to those of simple correspondence analysis. The variable 'overlap IE and PD' of knowledge of the curriculum and pedagogical competencies in teaching my subject field(s), student assessment practices and knowledge and understanding of my subject field(s) has merged with the variable 'only

part of IE' located as the vertical symmetry. Visually, the most prominent approximation is observed for the variable 'overlap IE and PD'.

4. Discussion and conclusion

Teaching skills and competencies of teachers accommodate several variables. Some examples include curriculum literacy, field knowledge, field teaching skills, class management, assessment and evaluation and practical communication skills. Wilks, Snow, Lasezik and Bowling (2019) underline that new age requires teachers set up multiple links, be collaborative, emphasise student-centredness, teach their students how to search and collect data and how to discern the differences, work with an inter-disciplinary perspective, be innovative and creative and have the skills to infuse high-level thinking, questioning and criticizing skills into their students. All these skills are among those targeted by teacher training programs both in Turkey and throughout the world at different times. Several countries (United States of America, Finland) support this process with their graduate programs as well (Aksoy & Gozutok, 2017).

Teachers' curriculum knowledge is related to many factors in the process of implementing the program. The order of importance of these factors may vary according to different views. It is stated by Liakopoulou (2011) that there is no doubt the importance of teachers' professional pedagogical competencies and field knowledge competencies in implementing the program, as well as their personal characteristics and their dedication to the teaching process. Teachers implement programs that are not developed by them. The details of teachers' understanding, adoption and use of program elements provide insight into whether classroom control goals can be achieved. For a successful teaching process, it is envisaged that teachers' knowledge of classroom discipline and attention to active students will be expertly adapted. It is also emphasised that tools need to be developed to teach teachers to provide classroom discipline by better reading the elements of programs (Monte-Sano, De La Paz & Felton, 2014).

According to the data set obtained from 17 countries participating in PISA 2015, the source that feeds the fields of curriculum knowledge, field knowledge and assessment and evaluation is the same, and they display a significant correspondence. Jonasson, Makitalo and Nielsen (2018) state that the connection teachers have with multiple sources of knowledge create a dilemma, but it also expands the field of action, which increases teachers' responsibilities. With respect to fields of professional competence, teachers mainly attain their skills and knowledge through either their education before service or both during their education before service and as part of their PD. In this sense, one can deduce that teachers primarily gain their relevant skills during pre-service years and that teacher training programs provide courses related to these fields. O'Flaherty and Beal (2018) conclude that the report published by the European Commission in 2013 determines teacher competencies across all fields by curriculum knowledge, educational theories and evaluation, field-specific teaching knowledge and the skill to tailor educational plans and practice to students' needs and contextual features. Research findings, when observed with such a glance, are consistent with the competencies outlined by the Commission's report. Yet, a closer examination of teacher training programs in Turkey (CHE, 2007) reveals that curriculum development course is studied for either 2 or 3 theoretical hours within social studies and guidance & psychological counselling teacher training programs, respectively. Apart from these, no other teacher training programs offer compulsory courses on curriculum development, but some have integrated several elective courses (Yesilyurt, 2013). Accordingly, some studies have pointed out that teacher candidates experience problems regarding their competence in curriculum development and other relevant fields (Ari, 2010; Sisman, 2017; Ulucinar Sagir & Karamustafaoglu, 2011; Yesilyurt & Semerci, 2013). As cited by Sisman (2017), for instance, only 1% of teachers get a printed copy of the new program, and 70% follow new changes in the program through course books or teacher manuals, as indicated by a report published by Turkish Education Association in 2009. However, there are some observable attempts in the new teacher training programs (YOK, 2018) to compensate teacher candidates' incompetence in the relevant fields.

Literature review yields that there are other research studies supporting the current research's finding that there is a significant relationship between the sources of curriculum knowledge and other fields of professional competence. Kirk and MacDonald (2001) report that there is a connection between how influential teachers are over curriculum changes and the depth of their embrace for the profession. Also, they also underline that the lack of teachers' voices when updates are made on the curriculum constitutes a major problem. There seems to be a consistent insist in the literature that teachers' PD is determined by the degree they are involved in the curriculum development process (Voogt, Pieters & Handelzalts, 2016; Penuel, Fishman, Yamaguchi & Gallagher, 2007). Curriculum development cannot be conceived apart from its first-hand practitioners, teachers. As concluded by Voogt et al. (2016), teachers' participation in the curriculum development process improves their knowledge about the program and skills to apply it. Yet, teachers struggle to adopt their roles as program designers (Mouraz, Leite & Fernandes, 2013). Teachers' active participation in the curriculum development process can only be achieved by establishing curriculum competencies. Likewise, teachers can attain relevant curriculum competencies via the courses they take during their education before service. Thus, it is crucial to enhance teacher training courses by including information, values and skills about the curriculum.

Sisman (2017) underpins that quality within the profession of teaching can be attained by equipping the candidates with information and skills about the concept, scope and function of curriculum and by training them about the structure of their field-specific curriculum, which plays a key role in terms of improving the quality and efficiency of teacher training programs in general. Fevre, Timperley and Ell (2016) conclude that teachers fulfil different roles in the classroom of the 21st century by partaking within the curriculum development process. They report that teachers have the roles of curriculum executive, curriculum creator and curriculum activist when troubleshooting problems encountered during the administration of the program. Besides, they also assign the role of 'program maker' to teachers since they are also definitive when determining the priorities of the curriculum.

On the other hand, another finding of the current research indicates that teachers head towards PD initiatives when they need to polish their teaching skills. In a study which compares teacher training policies and practice in Australia, Canada, Singapore and Finland with those in the United States of America in terms of employment, preparation and PD, Hammond (2017) underlines that a well-developed teacher training system should provide systematic support both at the beginning and during employment. This support can either be provided for the initial years in the profession or be continued in the form of PD in accordance with teachers' needs emerging during the following years. The author also suggests that such support can maintain quality in learning and offer career development opportunities, which will contribute to the sustainability of professional enthusiasm. The fact that the participants of the current study have expressed that they look for such opportunities to improve some of their teaching skills is highly consistent with the PD practice applied in these countries. This consistency can be interpreted as a sign showing that PD opportunities are provided systematically in many countries.

In conclusion, curriculum knowledge, among others, is an outcome targeted during pre-service years, and relevant courses are offered by teacher training programs together with other skill fields. Also, another finding points out that teachers are given PD opportunities in various forms and scopes depending on the country. As for future research endeavours, new programs can be compared with those of countries recently achieving high scores in PISA exams, and PD opportunities provided by high and low ranking countries in PISA exams can be contrasted.

Based on the findings of this research, one can suggest that the number of courses about curriculum is increased within teacher training programs and that different activities giving teacher candidates chances to adopt more active and participatory roles during both development and application of the curriculum be organised and administered. Furthermore, teachers should also be provided with in-service training opportunities regarding the curriculum they follow as they work. It should be remembered that appealing to teachers' opinions during curriculum updates may improve

the degree they embrace the profession. Teachers' weaknesses in the curriculum should constantly be monitored and tackled.

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