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Teacher Training Paradigms of Countries with High Science Performing: The Case of Singapore, Finland, South Korea and Türkiye in the Light of PISA and TALIS Data

Fen Başarısı Yüksek Ülkelerin Öğretmen Yetiştirme Paradigmaları: PISA ve TALIS Verileri Işığında Singapur, Finlandiya, Güney Kore ve Türkiye Örneği

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Abstract

This study aims to examine the teacher education paradigms of high-performing countries in science based on PISA and TALIS data. Conducted across Singapore, South Korea, Finland, and Türkiye, the research comparatively analyses teacher competencies, professional development, and teacher education systems. The study is structured through a descriptive analysis method, drawing on data from the 2015–2022 PISA cycles and the 2018 TALIS results. The findings reveal that Singapore and South Korea stand out for their systematic mentoring frameworks, comprehensive professional development models, and the time allocated for teacher preparation. Finland, on the other hand, enhances the quality of science teachers through graduate-level teacher education, practice schools, and research-based clinical models. Although Türkiye has implemented significant reforms in teacher education, it still exhibits areas for development, particularly in mentoring, the quality of professional development, and instructional planning time.TALIS data underscore that high science achievement is not solely the result of individual teacher efforts but is strongly associated with comprehensive, systematic teacher education policies. The study offers policy implications, particularly for Türkiye, by recommending elevating teacher education to the graduate level, institutionalising mentoring systems, and aligning professional development activities with classroom practices.

Keywords: Science achievement, teacher education, TALIS, PISA

Öz

Bu çalışma, PISA ve TALIS verileri ışığında fen başarısı yüksek ülkelerin öğretmen yetiştirme paradigmalarını incelemeyi amaçlamaktadır. Singapur, Güney Kore, Finlandiya ve Türkiye örnekleminde yürütülen araştırmada, öğretmen yeterlikleri, mesleki gelişim ve öğretmen yetiştirme sistemleri karşılaştırmalı olarak analiz edilmiştir. Betimsel analiz yöntemiyle yapılandırılan çalışmada, 2015–2022 PISA sonuçları ile 2018 TALIS verileri temel alınmıştır. Elde edilen bulgular, Singapur ve Güney Kore'nin sistematik mentorluk yapıları, kapsamlı mesleki gelişim sistemleri ve öğretmenlere sağlanan hazırlık zamanı gibi konularda öne çıktığını göstermektedir. Finlandiya'nın ise yüksek lisans düzeyinde öğretmen eğitimi, uygulama okulları ve araştırma temelli klinik modellerle fen öğretmenlerinin niteliğini artırdığı görülmektedir. Türkiye ise öğretmen yetiştirme sürecinde önemli reformlar gerçekleştirmekle birlikte mentorluk, mesleki gelişim niteliği ve planlama süreleri açısından hâlâ gelişim alanlarına sahiptir. TALIS verileri, yüksek fen başarısının sadece öğretmenlerin bireysel çabalarıyla değil, bütüncül ve sistematik öğretmen yetiştirme politikalarıyla sağlandığını ortaya koymaktadır. Çalışma, özellikle Türkiye için öğretmenlik mesleğini yüksek lisans düzeyine taşımayı, mentorluk sistemini kurumsallaştırmayı ve mesleki gelişimi sınıf içi uygulamalarla uyumlu hale getirmeyi önererek politika yapıcılar için çıkarımlar sunmaktadır.

Anahtar Kelimeler: Fen başarısı, öğretmen yetiştirme, TALIS, PISA

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1. Introduction

In recent years, significant transformations have occurred in education, with educational paradigms evolving alongside societal and technological advancements. Digitalisation has not only reshaped traditional instructional methods but also redefined how teachers and students engage in educational processes. This shift has simultaneously deepened teachers' professional development needs. The ability of teachers to effectively integrate digital tools and support their instructional techniques with such tools has become a critical determinant of educational success (Keller, Neumann, & Fischer, 2016).

To ensure that education systems cultivate individuals equipped with the knowledge, skills, and competencies aligned with societal expectations, both national and international assessment mechanisms are utilised to evaluate whether students have achieved the intended learning outcomes. Among these assessments are international examinations such as PISA, TIMSS, and PIRLS. The Programme for International Student Assessment (PISA), administered by the Organisation for Economic Co-operation and Development (OECD), is a prominent assessment conducted triennially. It evaluates the knowledge and skills acquired by 15-year-old students across member and partner countries (MEB, 2019; OECD, 2016).

Since its inception in 2000, PISA has assessed students' competencies in mathematics, science, and reading. Türkiye has participated in PISA since 2003, with each assessment cycle placing a rotating emphasis on one of the three domains. In each cycle, approximately half of the total testing time is dedicated to the selected major domain. For instance, reading literacy was the primary focus in 2000, 2009, and 2018; mathematical literacy in 2003, 2012, and 2022; and scientific literacy in 2006 and 2015. Beyond evaluating the extent to which students have learned the content presented in school curricula, PISA aims to assess their ability to apply this knowledge to real-life situations. It measures competencies such as problem-solving, reasoning, prediction, observation, and inference in both school and beyond-school contexts (OECD, 2016).

In addition to PISA, TALIS reports also provide significant data regarding teachers' professional competencies and instructional practices. By evaluating teachers' professional development, workloads, and teaching strategies, TALIS serves as a substantial data source for understanding cross-national teacher performance and for improving teacher education. These data reveal not only teachers' academic knowledge but also their pedagogical skills, job satisfaction, and educational environments (OECD, 2019).

While PISA serves as a guide for shaping international education policies, TALIS complements these data by providing in-depth insights into teachers' professional competencies, instructional strategies, and working conditions (OECD, 2019). A joint analysis of these two international data sets provides a significant foundation for understanding the relationship between student achievement and teacher quality.

According to OECD (2009), teacher competencies are defined as teachers' capacity to effectively apply the knowledge, skills, attitudes, and values necessary to facilitate student learning. The document titled General Competencies for the Teaching Profession, published by the Turkish Ministry of National Education (MoNE) on December 1, 2017, outlines the essential characteristics expected of teachers. The teacher profile is defined in three main dimensions—knowledge (3 sub-areas), skills (4 sub-areas), and attitudes and values (4 sub-areas)—comprising 11 sub-competencies supported by 65 performance indicators. Table 1 summarises the key competency areas and their corresponding sub-competencies as outlined in the *General Competencies for the Teaching Profession* (2017) published by the Ministry of National Education.

Table 1

General Competencies of the Teaching Profession and Their Sub-competencies (MoNE, 2017)

Competency domain	Sub-competencies
Professional Knowledge	Subject knowledge, subject education knowledge, legislation knowledge
Professional Skills	Planning, creating the learning environment, teaching management, assessment and evaluation
Attitudes and Values	Values, student approach, communication, personal/professional development

Within the framework of teacher competencies presented in Table 1 by the Ministry of National Education, a structure encompassing teachers' level of professional knowledge, instructional skills, and professional attitudes can be observed. This framework is utilised as a guiding tool in various areas, ranging from teacher education processes to career development. Accordingly, the competencies expected of a teacher can be generally listed as follows:

• The teacher creates effective learning environments by utilising subject-matter knowledge.
• Monitors and assesses student development.
• Encourages creative and critical thinking.
• Communicates effectively and collaborates with others.
• Abides by professional ethics and acts responsibly.
• Continuously engages in professional development.

Today, teacher competencies are no longer limited to pedagogical knowledge; they also encompass new domains such as digital literacy, interdisciplinary thinking, sustainability, and lifelong learning (Redecker, 2017). This transformation is also reshaping teacher education systems and introducing a new educational paradigm in which digital pedagogy, scientific literacy, and multidimensional teacher competencies come to the forefront (OECD, 2019).

In this context, the quality of science teachers, in particular, stands out as a key determinant of student achievement. Science teachers' subject-matter knowledge, pedagogical skills, and competence in effectively using digital technologies directly influence students' interest in science and their academic performance (Gess-Newsome et al., 2019; Keller, Neumann & Fischer, 2016; Kind, 2009). Therefore, teacher competencies have become a critical factor contributing not only to individual but also to systemic success.

The theory of teacher knowledge developed by Shulman (1986) is considered a foundational reference for explaining teacher competencies. Shulman emphasised that teaching is not limited to content knowledge and pedagogical knowledge, but that these two types of knowledge should be integrated under the concept of Pedagogical Content Knowledge (PCK). In education, pedagogical knowledge is as influential as content knowledge in determining student success. Teachers should develop both their subject-matter knowledge and pedagogical knowledge, integrating and harmonising them to facilitate learning more effectively (Gess-Newsome, 1999; Kind, 2009). PCK refers to a teacher's ability to present a specific topic in a way that students can comprehend. Particularly in the context of science education, it plays a crucial role in making abstract scientific concepts understandable and is considered a core component of teacher competency (Shulman, 1986; Magnusson, Krajcik, & Borko, 1999).

The scientific literacy assessed in PISA is closely associated with teachers' PCK (Pedagogical Content Knowledge) skills—such as relating science concepts to everyday life, taking students' prior knowledge into account, selecting appropriate instructional strategies, and making sense of laboratory processes. In TALIS, data related to instructional practices, self-efficacy, and types of professional development indirectly shed light on teachers' perceptions of and competencies in PCK (e.g., items such as "ability to teach according to student differences"). In a content-heavy and practice-oriented subject such as science teaching, PCK stands out as one of the most powerful teacher competencies influencing student achievement (Magnusson et al., 1999; Shulman, 1986). Magnusson et al. (1999) conceptualised PCK in science education as comprising the following components:

– **Science content knowledge** (scientific accuracy),
– **Knowledge of students' understanding of science** (misconceptions, readiness),
– **Knowledge of instructional strategies for teaching science** (inquiry-based learning, laboratory practices),
– **Knowledge of assessment in science teaching** (measuring conceptual understanding, alternative assessments),
– **Knowledge of the science curriculum** (the context in which content is placed).

The literature includes numerous comparative studies on teacher education systems (Ataman & Orhan, 2024; Avcı & Yücel-Toy, 2018; Göçen-Kabaran & Görgen, 2016; Mete, 2013; Orakçı, 2015; Özerbaş & Safi, 2022). These studies mostly focus on general teacher education policies, teacher recruitment systems, or teacher training models in developed countries. In the context of science teacher education, more specific contributions have been made by Can-Aran & Derman (2020), Çetinkaya, Taş, & Ergun (2014), and Ergun & Avcı (2013), who compared science teacher training programs across various countries in terms of scientific competencies; however, PISA and TALIS data were not included in these studies.

Studies utilising TALIS data, on the other hand, generally focus on teachers' self-efficacy, instructional practices, or job satisfaction (Koyuncu, 2025; Ötken, 2023; Uluman Mert, 2023). Research comparing teacher education systems across high-performing science countries through the combined lens of PISA and TALIS remains limited. In this respect, the present study aims to contribute to the literature through its thematic originality and holistic use of data sources.

The purpose of this study is to compare the teacher education systems of high-performing countries in science—namely, Singapore, Finland, and South Korea—with that of Türkiye, using TALIS data. The study seeks to reveal paradigm differences that are considered influential in teacher education and to present possible implications for Türkiye. In line with this purpose, the study sought to answer the following research questions:

1. Based on PISA results, how do the student achievement levels in science differ among Singapore, Finland, South Korea, and Türkiye?
2. In light of TALIS data, what similarities and differences exist in teachers' instructional practices, perceptions of self-efficacy, and professional development approaches in these countries?
3. What are the key structures and principles underlying the teacher education systems (initial education, induction, in-service support) of these countries?
4. What implications do the teacher education paradigms of high-performing countries in science offer for Türkiye?

2. Method

Research Design

This study employed a descriptive analysis method, situated within qualitative research. Descriptive analysis is a methodology used in qualitative research that involves analysing existing documents, perspectives, or archived data within the framework of pre-determined themes. The goal of this analysis is to present the obtained data in a meaningful, organised, and readable manner. It often includes document analysis, comparative analysis, and basic coding techniques (Yıldırım & Şimşek, 2021).

In this research, the policies and practices regarding teacher competencies in Singapore, Finland, South Korea, and Türkiye were comparatively analysed in light of TALIS and PISA data. The data were interpreted under pre-determined themes (e.g., instructional practices, professional development, competency structures), and the performance levels of the countries were comparatively evaluated.

Data Collection and Analysis

The data for this study were obtained from the PISA 2015, 2018, and 2022 results reports (OECD); the TALIS 2018 teacher survey reports; national reports of the relevant countries; academic literature; and thematic review documents published by the OECD. Additionally, the OECD's thematic report based on the TALIS study titled "Science Teachers' Satisfaction (STS)" (2018) was also utilised as a primary data source (Mostafa & Pál, 2018). This report presents a comparative analysis of science teachers' job satisfaction, professional development, and school environment across countries.

The data were accessed via the official OECD website, open-access resources provided by the Ministry of National Education (MoNE), and national reports from the selected countries. Tables, graphs, and summary findings presented in these reports were categorised into predefined thematic categories, such as instructional practices, professional development, and competency frameworks.

Although the 2022 PISA results serve as the central reference point for the study, the corresponding TALIS data have not yet been published; therefore, the most recent available data—TALIS 2018—were used. Furthermore, in TALIS 2018, Finland (Europe) and Singapore and South Korea (Asia) were among the countries that stood out in terms of teacher competencies and professional development indicators (Ceylan, Özdoğan Özbal, Sever & Boyacı, 2020). This was a key factor in their selection for the study sample.

In comparing Türkiye with countries that achieve high levels in science, particular emphasis was placed on the intersection between PISA science results and TALIS teacher competency indicators. Cross-country comparisons were conducted based on percentage values presented in tables and graphs from these datasets.

The data were analyzed through the descriptive analysis method. The analysis process was structured in three stages: first PISA science scores for the selected countries were evaluated as outcome indicators, secondly key indicators from the TALIS 2018 dataset—such as instructional practices, self-efficacy perceptions, participation in professional development, and use of technology—were compared on a country-by-country basis, Finally, the teacher education systems of the countries were examined, and their similarities and differences were identified in line with various educational paradigms.

Validity and Reliability

The PISA, TALIS, and OECD thematic reports used in the study consist of data sets that are internationally recognised for their validity and reliability. Therefore, the findings from the document analysis are considered highly accurate and representative. The criteria of accessibility, currency, and relevance to the subject were considered when selecting the documents.

In the creation of the thematic framework, TALIS 2018 data, which is based on teachers' self-reports, was utilised. During this process, interviews were conducted with science education experts (one of whom was an academic), and the themes were refined based on their feedback. Additionally, because some data in the TALIS 2018 reports were presented graphically, the percentage values for teacher indicators were approximated from the graphs. In this process, two subject matter experts independently reviewed the value of each indicator and showed 85% agreement. An inter-coder agreement rate of 80% or higher is considered an acceptable threshold in qualitative research (Miles & Huberman, 1994; Patton, 2002). To determine consistency, the following equation was used:

Consistency = (Agreement instances / Total number of themes) x 100

It was also observed that the rates reported by the experts, where differences arose, were approximately the same. For instance, while the first researcher determined the rate of "self-perceived sufficiency in using ICT" as 42%, the second researcher set it at 43%. To address unresolved points, the researchers revisited their opinions and established a standard rate, resulting in a final consolidated table. The data sources, analysis process, and table-creation stages of the study were reported in detail, thereby enhancing the verifiability of the findings and increasing the repeatability of the study.

Ethical Considerations

All data used in this study are secondary data obtained from publicly accessible academic publications, official reports, or statistical databases. No personal data were accessed or used. Therefore, ethical approval from a research ethics committee was not required for this study.

3. Findings

PISA evaluates student performance in three core domains—reading, mathematics, and science literacy—in each assessment cycle. However, one of these domains is designated as the primary domain in each cycle, enabling a more in-depth exploration of student competencies in that area. In PISA 2015, science literacy was the primary domain, followed by reading in 2018 and mathematics in 2022.

Türkiye's Performance in Science Literacy in PISA Assessments (2006-2022)

The following table presents Türkiye's science literacy scores and rankings from the PISA assessments conducted between 2006 and 2022. While this information does not directly correspond to a specific research question, it is crucial to understand the trends in Türkiye's performance over time, as it serves as a foundational comparison for the later analyses on the impact of teacher education systems

Table 2
Türkiye's PISA Science Literacy Scores and Rankings

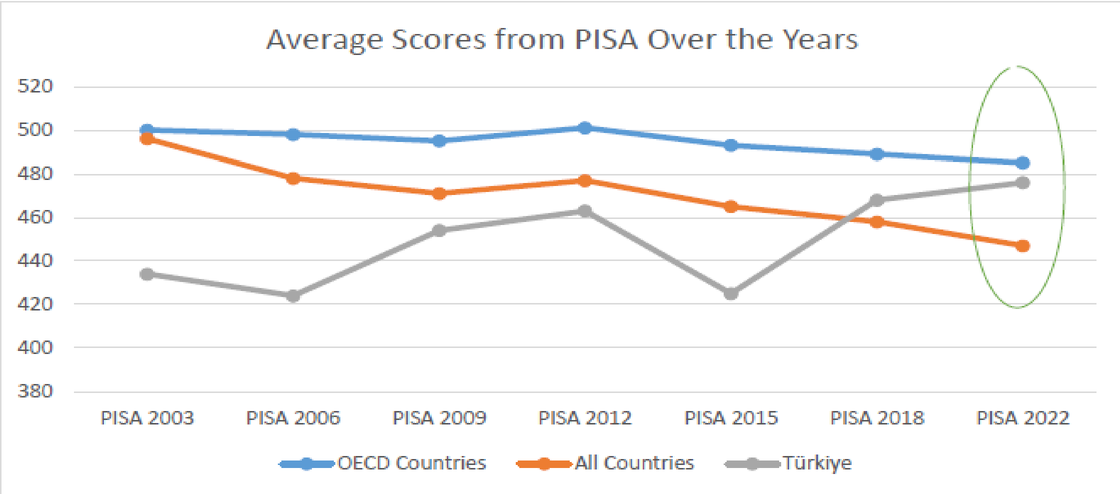
Year	Mean Science Score	Ranking / Number of Participating Countries in PISA
2003	434	35/40
2006	424	42 / 57
2009	454	43 / 65
2012	463	43 / 65
2015	425	52 / 72
2018	468	39 / 79
2022	476	34 / 81

As shown in Table 2, Türkiye's performance in science literacy has significantly improved from 2006 to 2022. This table helps contextualise Türkiye's progress in science education and provides a backdrop for analysing how the country compares with high-performing countries such as Singapore, Finland, and South Korea, as explored in subsequent research questions. Between 2018 and 2022, Türkiye's science literacy scores have increased notably. This improvement could serve as a significant indicator in understanding the impact of teacher education systems.

Figure 1 provides a comparative analysis of Türkiye's average science literacy scores alongside those of OECD countries and all other PISA participants. While this figure does not address a specific research question, it visually illustrates Türkiye's standing in the broader international context, which is essential for understanding the effectiveness of Türkiye's educational policies relative to other high-performing countries.

Figure 1

Average science literacy scores of Türkiye, OECD countries, and all PISA participating countries



	PISA 2003	PISA 2006	PISA 2009	PISA 2012	PISA 2015	PISA 2018	PISA 2022
OECDCountries	500	498	495	501	493	489	485
All Countries	496	478	471	477	465	458	447
Türkiye	434	424	454	463	425	468	476

(Source: MoNE, 2022 PISA Türkiye Report)

Figure 1 presents the average science literacy scores of Türkiye, OECD countries, and all PISA participants over the years, providing a visual comparison of Türkiye's performance relative to other countries. Figure 1 illustrates the change in Türkiye's science literacy scores from 2003 to 2022, highlighting an upward trend in performance. The figure complements the data in Table 2, showing improvements in Türkiye's average scores and international rankings over time.

1. Student Achievement in Science in Singapore, Finland, South Korea, and Türkiye Based on PISA Results

Table 3 presents the science literacy rankings from the last three PISA cycles for the countries selected in this study.

Table 3

PISA Science Literacy Scores and Rankings of Türkiye, Finland, South Korea, and Singapore (2015–2022)

Year	Türkiye Score (Rank))	Finland Score (Rank)	South Korea Score (Rank)	Singapore Score (Rank)
2015	425 (54/72)	531 (7/72)	516 (7/72)	556 (1/72)
2018	468 (39/79)	522 (10/79)	519 (9/79)	551 (1/79)
2022	476 (34/81)	511 (9/81)	528 (5/81)	561 (1/81)

Since PISA 2015 designated science literacy as its primary domain, Table 3 includes results from 2015, 2018, and 2022 to reflect trends in science performance. The data presented in Table 3 provide a comparison of science literacy achievements among Singapore, Finland, South Korea, and Türkiye, shedding light on the changes in their respective PISA rankings. Singapore has consistently ranked first across all three time periods, demonstrating sustained high performance in science literacy, reflecting the effectiveness of its education system. South Korea, while maintaining a top-10 position in each period, has seen little change in its ranking over time. Finland, although experiencing a slight decline in its ranking between 2015 and 2022, has remained among the top-ranking countries. Türkiye, on the other hand, has shown a significant improvement in its science literacy scores, particularly between 2015 and 2022. In 2015, Türkiye ranked 54th, but by 2022 it had risen to 34th.

These findings highlight significant differences in science literacy achievement across countries. While Singapore and South Korea demonstrate notable consistency in their performance, Finland and Türkiye's rankings have changed due to reforms implemented in their education systems. Specifically, Türkiye's rapid improvement in its ranking may be indicative of the recent reforms and advancements made in teacher training. The data from this table provide insights into the impact of national education systems and highlight key factors that influence student performance in science. These findings enable a more detailed examination of the effects of educational policies and teacher training systems on science literacy outcomes across countries.

The PISA science literacy scores presented in Table 3 reflect students' ability to think, interpret, and solve problems based on scientific knowledge. One of the most influential factors behind these performance levels is teacher quality (Darling-Hammond, 2010; OECD, 2019). Accordingly, Table 4 presents TALIS indicators for key variables, including teacher support and mentoring, professional development, job satisfaction, and working hours, across the selected countries. These data help illuminate possible connections between teacher-related factors and science literacy outcomes.

2. Teaching Practices, Self-Efficacy Perceptions and Professional Development Approaches of Teachers in Finland, South Korea, Singapore and Türkiye According to TALIS Data

The TALIS data presents key indicators, including teachers' access to mentoring support, professional development, and the time spent on lesson preparation. The TALIS study is conducted across four educational levels according to the International Standard Classification of Education (ISCED). In TALIS 2018, 15 countries participated at the primary level (ISCED 1), 48 at the lower secondary level (ISCED 2), and 11 at the upper secondary level (ISCED 3). Türkiye participated at all levels, with approximately 19,000 teachers, 957 principals, and 971 schools involved (OYGM, 2018). A total of 29 OECD countries took part in TALIS 2018.

Table 4

Teacher Indicators Based on TALIS 2018: Comparison of Selected Countries and OECD Average

Indicator		OECD Avg.	Finland	S. Korea	Singapore	Türkiye
Mentoring support (Assignment of a mentor to beginning teachers)		% 22	% 6	% 10	% 30	% 8
Participation in professional development(Attended at least one activity in the past 12 months)		% 94	% 92	%97	%98	% 93
Time spent individually on lesson preparation		6.5 hours	5 hours	7 hours	8 hours	2.5 hours
Weekly working hours*		29 hours	28 hours	26hours	32 hours	30 hours
Share of students whose first language is different from the language of instruction		% 20	% 18	% 2	% 80	% 22
Use of technology(Frequent use of ICT in student projects)		% 53	% 51	% 30	% 43	% 67
Teachers trained in ICT use		% 56	% 56	% 59	%88	%71
Teachers feeling confident in ICT use		% 43	% 21	% 48	% 60	% 61
Self-efficacy (classroom management)		% 85	% 82	% 82	% 79	% 90
Job satisfaction (overall)		Moderate-high	Moderate	High	High	Moderate
Teaching as first career choice		% 66	% 59	% 80	--	--
Educational attainment	Associate degree	% 17	% 1	--	% 2	% 0.7
	Bachelor’s degree	% 54	% 6	% 62	% 70	% 92
	Master’s degree	% 33	% 85	% 35	% 25	% 7
	Doctoral degree	% 2	% 3	% 3	% 3	% 0.3

Table 4 presents a comparative overview of key indicators from the TALIS 2018 study, including teacher competencies, professional development, job satisfaction, technology use, and educational qualifications for Türkiye, Finland, South Korea, and Singapore, alongside the OECD average. The data were organised to highlight national patterns and to facilitate implications regarding teacher education policies. The table is based on self-reported responses from teachers, in accordance with TALIS's core methodology. While some indicators are represented as percentages, others are expressed as approximate frequencies or trends due to the nature of the original dataset. In cases where exact figures were not directly available in the reports, values were approximated based on visual graphs or summarised charts.

Mentoring Support (Assignment of Mentors to Beginning Teachers): While the OECD average is 22%, Singapore significantly surpasses this figure at 30%, the highest among the selected countries. In contrast, Finland (6%), South Korea (10%), and Türkiye (8%) fall well below the OECD average, indicating a relative lack of structured mentoring systems for novice teachers. In Singapore, the proportion of newly appointed teachers assigned mentors is relatively high (30%), whereas in Finland it is much lower (6%). This disparity suggests that the support teachers receive in their professional development may differ significantly between the two countries. Singapore's strong mentorship system may facilitate more rapid and effective professional growth for teachers, whereas in Finland, teachers may be expected to practice their profession more independently.

Participation in Professional Development Activities: This indicator reflects the percentage of lower secondary teachers who participated in at least one professional development activity during the 12 months before the survey. The rates are notably high across all countries: Singapore at 98%, South Korea at 97%, and Türkiye at 93%, closely aligning with the OECD average of 94%.

Individual Time Spent on Lesson Preparation: Singapore reports the highest individual time spent on lesson planning at 8 hours per week, whereas Türkiye reports the lowest at 2.5 hours. The OECD average is 6.5 hours, highlighting a substantial disparity between Türkiye and the other countries. In Türkiye, teachers spend significantly less time on lesson preparation compared to those in Singapore and other high-performing countries. This difference may be primarily attributed to the higher workload of teachers in Türkiye, who are often more engaged in additional administrative responsibilities, as well as differences in teaching strategies.

Weekly Working Hours: While OECD teachers work an average of 29 hours per week, the weekly workload varies across countries: Singapore reports 32 hours, Türkiye 30 hours, Finland 28 hours, and South Korea 26 hours. It is important to note that the original data differentiate between novice teachers (less than 5 years of experience) and more experienced teachers (more than 5 years of experience); the reported values are averaged across both groups.

Proportion of Students with a First Language Other than the Language of Instruction: The OECD average is 20%, whereas Singapore reports a significantly higher proportion at 80%, followed by Türkiye at 22%, Finland at 18%, and South Korea at only 2%. Singapore's exceptionally high percentage can be attributed to its multilingual and multicultural societal structure, which naturally leads to greater linguistic diversity in classrooms. This situation highlights the importance of teachers in Singapore being equipped with strong communication skills to engage effectively with diverse linguistic groups. The 22% figure in Türkiye may raise questions about the impact of linguistic diversity on classroom interactions. In Finland, the 18% rate may reflect a more homogeneous society with less linguistic diversity.

Use of ICT (Information and Communication Technology) in Student Projects: While 53% of OECD teachers frequently integrate ICT in student project work, this rate is highest in Türkiye at 67%, followed by Finland at 51%, Singapore at 43%, and South Korea at 30%. With 67%, Türkiye's technology usage is significantly higher than the OECD average of 53% and higher than Singapore (43%) and Finland (51%). The lower levels of technology use in digitally advanced education systems, such as those in Singapore and Finland, may reflect more limited integration of technology within their educational frameworks and varying degrees of digitalisation. In contrast, Türkiye's higher percentage suggests that technology usage in education is becoming more widespread, with teachers increasingly adopting digital tools in their teaching practices. However, when considered alongside other factors, this figure suggests there is still considerable potential for further development in the efficient use of digital educational tools in Türkiye.

Teachers Trained in ICT Use: A majority of teachers across all countries have received ICT training. The highest rate is in Singapore (88%), followed by Türkiye (71%), South Korea (59%), and Finland and the OECD average, both at 56%. This suggests that teachers in Türkiye have received relatively high levels of training for technology integration. In comparison, Singapore reports that 88% of its teachers have undergone ICT training, while Finland (56%) and South Korea (59%) are behind Türkiye in this regard. Singapore's high percentage reflects a well-structured educational framework that emphasises systematic technology training, ensuring that teachers develop high-level digital skills. The 71% rate in Türkiye indicates that teachers are well-equipped in terms of digital competencies.

However, as in Singapore, further integration and application of technology within the education system may still be required to realise its potential in the classroom fully.

Teachers' Confidence in ICT Use: Regarding teachers' self-perceived competence in using ICT, Türkiye reports the highest level at 61%, closely followed by Singapore (60%), South Korea (48%), and the OECD average (43%). Finland reports the lowest self-efficacy in this domain, at only 21%. The high rates in Türkiye and Singapore suggest that teachers feel more confident in their use of technology. In contrast, the lower rate in Finland indicates a need for further training in technology integration. The high rate in Türkiye may reflect that teachers feel adequately equipped to use technology, yet it also suggests that, as in Singapore, more practical experience and strategies are needed within highly digitalised, technology-driven educational systems.

Self-Efficacy in Classroom Management: Teachers' self-efficacy in classroom management is generally high across countries. Türkiye leads with 90%, followed by the OECD average (85%), Finland (82%), South Korea (82%), and Singapore (79%). In this area, where Türkiye has the highest self-efficacy rate at 90%, it can be inferred that Turkish teachers feel more confident in classroom management than teachers in other countries. However, this could be explained by teachers' working conditions and professional development processes. The lower rate in Finland (82%) may serve as an essential indicator for understanding different approaches to classroom management and teachers' professional perspectives.

Job Satisfaction (Overall): OECD teachers report a "moderate-to-high" level of overall job satisfaction. Among the selected countries, teachers in Singapore and South Korea report high satisfaction, Finland reports moderate satisfaction, while Turkish teachers also report a moderate level of contentment with their profession. This may reflect differences in teachers' working conditions, social status, and professional prestige. The moderate levels of teacher satisfaction in Türkiye and Finland could indicate potential challenges educators face in these countries.

Teaching as a First Career Choice: The proportion of teachers who chose teaching as their first career option is 66% across OECD countries. This figure stands at 59% in Finland and 80% in South Korea. Data for Singapore and Türkiye are not available in the current dataset.

Educational Attainment: OECD teachers hold associate degrees (17%), bachelor's degrees (54%), master's degrees (33%), and doctoral degrees (2%). In Finland, 85% of teachers hold a master's degree, which is the highest among the group. In Türkiye, 92% of teachers hold a bachelor's degree, while only 7% hold a master's degree and 0.3% hold a doctorate. The high master's degree rate of 85% in Finland may indicate the emphasis placed on teachers' professional development. Similarly, it can be argued that in Türkiye, teachers need to pursue more professional training at the master's level.

3. Teacher Education Systems in Singapore, Finland, South Korea, and Türkiye

Finland's Science Teacher Training Paradigm

Finland's education system is grounded in the principle of educational equity. It emphasises every individual's right to access high-quality education, regardless of their ethnicity, language, or place of residence. The Opetushallitus (OPH) — Finnish National Agency for Education (FNAE) — is responsible for developing national curricula and educational policies. It prepares the National Core Curriculum for both basic and secondary education, defining overarching goals and content. Schools and regional institutions are then expected to develop local curricula in alignment with this national framework. Each school adapts its teaching plan based on OPH's general objectives. Teachers actively participate in this process, engaging in curriculum development, pedagogical innovation, and localisation efforts (EDUFI, 2022).

In Finland, teaching is a highly respected profession within society (Niemi & Lavonen, 2020). Universities independently select teacher candidates through a highly competitive admissions process. Applicants undergo a rigorous three-stage selection system: a written exam, followed by individual interviews, group tasks, and micro-teaching practices. For science teacher applicants, emphasis is placed on demonstrated success in science-related subjects. The acceptance rate remains below 10%, making it as competitive as medical school admissions (Sahlberg, 2010).

Both pre-service and in-service professional development systems are meticulously structured, with strong encouragement for teachers to update their professional competencies (EDUFI, 2022) continuously. A master's degree is mandatory for all teachers. For science teachers, this typically involves a five-year integrated program: three years of undergraduate studies followed by two years of graduate education (Bachelor + Master). The curriculum encompasses courses in research methods, scientific reasoning, educational psychology, and didactics. Teacher candidates receive extensive instruction in both content knowledge and pedagogical content knowledge

(PCK). These programs emphasise laboratory-based science teaching, model-based reasoning, and inquiry-based instruction. Candidates engage in practical work on topics such as student understanding, misconceptions, and alternative assessment strategies—key components of PCK (Niemi & Lavonen, 2020).

To develop pedagogical content expertise, science teacher candidates must first complete subject-matter training in science faculties before undergoing pedagogical education in faculties of education. Those who successfully complete this pedagogical coursework are placed in teacher training schools. One of the most distinctive features of teacher education in Finland is the integration of theory and practice. Every faculty of education is partnered with practice schools that provide opportunities for hands-on training. Candidates participate in a two-year practicum program structured into four phases—three conducted within practice schools affiliated with universities, and one in public schools (Çetinkaya, Taş & Ergun, 2014).

Approximately one-third of pedagogical training is allocated to practical internships. These are conducted under the joint supervision of experienced school teachers and university faculty, making the Finnish model closely aligned with a clinical model of teacher education (Niemi & Lavonen, 2020). Throughout their careers, teachers are encouraged to participate in academic and scientific activities within their field. While in-service training is not mandatory in Finland, teachers are expected to pursue professional development based on their own needs and interests (EDUFI, 2022).

Table 5
Science Teacher Education System in Finland

Component	Description
Official Curriculum	National Core Curriculum (NCC)
Curriculum Developers	Collaboration between FNAE and the Ministry of Education
Science Teacher Training	3-year bachelor's + 2-year master's; includes pedagogical and methodological training
Modular Structure	Educational sciences, content-didactics, practicum, and mentored internships
Local Implementation	Schools and local bodies develop localized curricula aligned with national goals
Internship and Practicum	Approx. 1/3 of credits involve mentored practice in affiliated training schools
Quality Assurance	Monitored by FINEEC, teaching is a highly prestigious profession
Mentor Support	While formal mentoring is limited, robust master's programs and training school models mitigate this need

In Finland, the process of training science teachers is based on a system where the teaching profession holds high prestige. Teacher candidates undergo a five-year university-level education, which combines pedagogical knowledge, subject-specific expertise, and practical experience. In addition to theoretical training, science teacher candidates receive substantial hands-on experience and mentorship support. Furthermore, great emphasis is placed on teachers' professional development, and upon completing their training, they are required to continue participating in professional development programs. The Finnish system encourages teachers to have high autonomy, allowing them to innovate in their teaching methods and pedagogical skills.

South Korea's Science Teacher Training Paradigm

In South Korea, the Ministry of Education (MOE) is responsible for formulating teacher education and professional development policies and for regulating teacher certification. One notable characteristic of the South Korean teacher education system is the structural separation between institutions that train primary and secondary school teachers (Im, Yoon & Cha, 2016; MOE, 2025). This distinction is closely related to the country's historical trajectory.

Following the Korean War (1950–1953), the country entered a phase of industrialisation during the 1960s, which accelerated in the 1970s. As a result of industrialisation, the number of school-age children increased significantly, while the attrition rate among primary school teachers also rose. Consequently, South Korean society faced growing pressure to meet the demand for qualified primary school teachers (Im et al., 2016; Lee, 2025).

Teacher education in South Korea is conducted at the undergraduate level over a period of four years. Upon completing the four-year program, teacher candidates are awarded a **Level 2 Teaching Certificate**. After completing three years of teaching experience and successfully finishing 15 credits of in-service training, candidates become eligible for the **Level 1 Teaching Certificate** (MOE, 2025).

Primary school teachers are trained exclusively at designated education universities and faculties (Faculties/Universities of Education – FUCE). Secondary science teachers, on the other hand, may be trained through three distinct pathways:

- **Undergraduate Certification-Oriented System (FUCE)**: Teacher education programs offered at faculties of education,
- **Open Undergraduate Certification System (OUCE)**: Students in non-education faculties can take pedagogical courses required for certification,
- **Postgraduate Certification System (PGCE)**: Pedagogical formation programs at the graduate level after a bachelor's degree.

These multiple pathways have led to structurally distinct and independently organised systems for the preparation of primary and secondary science teachers (Cho et al., 2006). The South Korean science teacher education system is shaped by a selective recruitment process based on centralised exams, a balance between content knowledge and pedagogical training, extensive practical teaching experience, and comprehensive in-service professional development. This structure aims to ensure quality assurance in science instruction and support sustainable professional development (EDU/EPDC, 2024).

Science teacher preparation programs at the secondary level are conducted in four main departments—Physics, Chemistry, Biology, and Earth Science—within faculties of education. Students are admitted separately into each department, and each department conducts its own independent selection process. Science teacher education in South Korea is thus organised by subject-specific branches, although secondary science classes are often taught in an integrated format (Im et al., 2016; MOE, 2025).

Candidates for both primary and secondary teaching are required to complete a minimum of 50 credits in subject content courses and at least 22 credits in teacher professional (pedagogical) coursework. The curriculum emphasises both content knowledge (e.g., physics, chemistry) and pedagogical content knowledge (PCK). The South Korean teacher education system is generally academic in nature; clinical-based models—such as extended school-based practice and mentoring—are not widespread. However, there has been increasing demand in recent years for more practice-oriented teacher education models. In addition, the content of teaching practicum courses is updated in accordance with societal needs (e.g., school violence prevention) (Im, Yoo & Pak, 2001).

The Level 2 Teaching Certificate obtained upon graduation does not automatically entitle candidates to employment. To obtain a Level 1 Certificate, teachers must complete three years of service and in-service training programs (Im et al., 2001; Im et al., 2016; Saracaloğlu & Ceylan, 2016).

Teaching is a highly respected and sought-after profession in South Korean society. In East Asian cultures, showing respect for teachers is a long-standing historical and cultural tradition (Liu, Liu, & Wang, 2015). Furthermore, job security and competitive salaries make teaching an attractive career path for many young Koreans. Teachers working in national and public schools are considered civil servants and enjoy lifetime job security and retirement pensions (Im et al., 2016).

However, possession of a teaching certificate does not guarantee employment. To work in public schools, candidates must pass a national teacher recruitment examination. Given the high number of science education graduates and the limited number of vacancies, the examination process is highly competitive. Private schools, on the other hand, conduct their own recruitment procedures independent of the national system (Im et al., 2016; Saracaloğlu & Ceylan, 2016).

South Korea consistently achieves high scores in international student assessments in mathematics and science. The country performs exceptionally well in global benchmarking exams such as TIMSS and PISA. For example, in the 2009 PISA assessment, Korea ranked 2nd in reading, 4th in mathematics, and 6th in science. In the 2012 PISA results, Korea was ranked 1st in mathematics and 2nd in science among OECD countries.

It is difficult to explain these achievements through a single theoretical framework. Nevertheless, examining science teacher education in South Korea through a holistic lens can help uncover the structural and pedagogical factors underlying student success in primary and secondary science education (EPU/EPDC, 2024).

Table 6
Science Teacher Education System in South Korea

Component	Description
Official Curriculum	A standardised national curriculum for teacher education is strictly regulated through laws and regulations by the Ministry of Education (MOE).
Curriculum Developers	Determined by MOE and relevant government bodies (e.g., Korea Institute for Curriculum and Evaluation); separate institutions for primary and secondary education.
Science Teacher Education	Four-year undergraduate programs; separate education faculties (FUCE) for primary teachers; three distinct routes for secondary science teachers (FUCE, OUCE, PGCE).
Program Structure	Minimum 50 credits in subject content, 22 credits in pedagogy; strong emphasis on content and pedagogical content knowledge (PCK); practicum courses aligned with societal needs.
Local Practice	Clinical models, mentoring, and long-term internships are not common; practicum is usually short-term and limited; there are growing calls to expand practical components.
Practicum and Pedagogical Practice	Minimum 4 credits in teaching practicum; updated content in response to contemporary social issues.
Quality Assurance	Government conducts regular audits and evaluations; teaching certificates are valid for life, but in-service training is required for Level 1; teaching has high social status, but performance evaluations are limited.
Mentorship Support	Mostly limited to student teachers' practicum periods.

The process of teacher education for science teachers in South Korea begins at the university level and includes stages of pedagogical formation and practical training. After completing their undergraduate education, teacher candidates receive pedagogical training, focusing on discipline-based instruction and classroom practices. While rigorous selection processes and exams are used for science teaching positions, teachers are required to participate in continuous professional development courses. The teacher education process is supported by mentoring and evaluation. This system, overseen by the Ministry of Education (MOE), ensures that teachers are equipped with a balanced foundation of pedagogical knowledge and subject expertise. Teaching is regarded as a prestigious profession, with quality assurance ensured through regular inspections and in-service training; however, the practical training process is limited, and in-service performance evaluations are insufficient.

Singapore's Science Teacher Training Paradigm

Although teacher education in Singapore began during the colonial period, the presence of a comprehensive teacher education provider did not materialise until 1950. After Singapore gained independence in 1965, the Teachers' Training College initially operated as a teacher education department within the Ministry of Education and then rapidly expanded its capacity as a statutory board. In 1991, with the aim of elevating the status of teacher education, the Teachers' Training College was transformed into an autonomous institute within the newly established Nanyang Technological University (NTU) (Loh & Hu, 2019).

The teacher preparation process in Singapore has a centralised structure and is conducted exclusively by the National Institute of Education (NIE). NIE is affiliated with NTU and solely administers all teacher preparation programs (undergraduate, postgraduate, and certification). To become a teacher in Singapore, one must receive teacher education at NIE. The institute specialises in teacher preparation across all disciplines—including the sciences (Loh & Hu, 2019; Tan, 2018).

Science teacher candidates receive a four-year undergraduate education leading to the Bachelor of Science (Education) — BSc(Ed). In addition, they specialise in two separate science subjects (e.g., Physics & Chemistry). Candidates who aim to teach at the secondary level are given specialisations in two disciplines. Candidates who will teach at the primary level may select a science specialisation in one of these two areas.

The curriculum includes instruction in scientific disciplines and pedagogy (curriculum studies, classroom management, micro-teaching), as well as 22 weeks of in-class practice. At the postgraduate level, the Post-Graduate Diploma in Education (PGDE) is offered as a 16-month program with a strong emphasis on pedagogical content. The core assumption underlying the PGDE program is that candidates already possess sufficient content knowledge in their respective fields (biology, physics, chemistry). Therefore, the program does not include direct science content (Tan, 2018).

At NIE, science teaching is delivered within the framework of the "Science Syllabus," with courses focusing on laboratory practice, inquiry-based methods, scientific argumentation, and conceptual understanding. Micro-teaching and a 10-week science practicum take place in schools (for PGDE: 4 weeks of observation, 10 weeks of practicum) (NTU, 2023; Tan, 2018).

- *What* is to be taught is fixed by the science curriculum determined by the Ministry of Education.
- *When* and to *whom* it is to be taught is shaped by the school's work plans and student groupings.
- *Where* it is to be taught is planned by the school's resource team.

Accordingly, the most important competency for teacher candidates is to ensure that students achieve the targeted learning outcomes by applying instructional methods in innovative ways (Tan, 2018).

For candidates who wish to become primary school teachers, NIE offers three distinct programs, while a single program is offered for those aiming to become lower secondary teachers. During this process, teacher candidates undergo a structured mentoring system under the guidance of both a senior teacher at the school and an academic advisor from NIE (Tan, 2018).

These programs not only equip candidates with up-to-date pedagogical and disciplinary knowledge but also provide comprehensive preparation for situations they may encounter across different stages of the teaching profession. This understanding aligns with the "front-loading" approach that underpins Singapore's teacher education model. The rationale is: "learn extensively, because you cannot know in advance what you will need and when." In line with this approach, the knowledge and skills candidates may require are delivered intensively during pre-service education (Tan, 2018). The teaching profession has historically held high prestige in Singapore, influenced by Confucian thought. Moreover, the international achievements of students taught by Singaporean teachers further enhance the profession's social prestige (Saraçaloğlu & Ceylan, 2016). Consequently, the selection process for teacher candidates is highly rigorous and competitive. Candidates are generally expected to rank within the top third in A-Level examinations. In addition, candidates are subject to the Ministry of Education (MOE) bonded teacher scheme, and successful performance during this period leads to admission into an NIE program (Tan, 2018).

Candidates must pass through multiple assessment stages before being admitted to NIE. A high upper-secondary graduation score is one of the basic prerequisites for applying to faculties of education. Each year, the government calculates the required number of teachers and sets the intake quota accordingly; applications are accepted only within this quota. Approximately 1 in 8 applications to teacher education schools are accepted. Candidates must succeed in the nationally administered, highly demanding GCE A-Level examinations, undergo interview and observation processes, and be evaluated on personal competencies, academic achievement, initiative, and social contribution (Saraçaloğlu & Ceylan, 2016; Tan, 2018).

The science teacher preparation process in Singapore is distinguished by a "continuous professional development model" that encompasses not only pre-service education but also ongoing professional learning. There are two fundamental reasons for describing this model as "continuous": First, MOE provides sustained funding to support teachers in returning to NIE for further education later in their professional careers. Second, in-service development courses are designed to build upon the knowledge and skills acquired during pre-service education (Tan, 2018).

All teachers are entitled to 100 hours of professional development per year. MOE and NIE support this development, while the Academy of Singapore Teachers (AST) promotes professional leadership and collaboration among teachers. Professional development courses are crucial for helping teachers stay current and innovative. These courses are shaped according to teachers' needs through cooperation with the MOE. MOE analyses teachers' needs with schools, communicates this information to NIE, and requests the development of corresponding content. NIE, for its part, proposes its own courses to MOE and seeks funding approval. The courses designed with contributions from both parties are made available to teachers as an annual professional development catalogue (Tan, 2018).

Table 7
Science Teacher Education System in Singapore

Component	Description
Official Curriculum	The curriculum for science teacher education programs is prepared through collaboration between the Singapore Ministry of Education (MOE) and the National Institute of Education (NIE).
Curriculum Developer(s)	NIE develops teacher education programs under the guidance of the MOE. NIE is responsible for both curriculum design and implementation.
Science Teacher Education	Pre-service education typically consists of a **four-year undergraduate** program. **Post-Graduate Diploma in Education (PGDE)** programs are also available. In PGDE, holders of a bachelor’s degree are assumed to possess content knowledge. In the undergraduate program, science didactics is taught alongside pedagogical content. The “**Teach Less, Learn More**” philosophy is adopted.
Program Structure	The curriculum comprises science content courses, pedagogical methods, curriculum studies, and micro-teaching. Separate modules exist for sub-disciplines such as biology, chemistry, and physics for pre-service teachers.
School-Based Implementation	School-based practicum is structured and supported by mentoring; candidates teach under the guidance of both a school mentor and an academic advisor from NIE.
Practicum and Practice	Classroom-based teaching practice is compulsory in all programs: **BSc(Ed): 22 weeks total**; **PGDE: 10 weeks** (following 4 weeks of observation).
Quality Assurance	Joint performance evaluations by NIE and MOE are conducted through portfolios, observation forms, and continuous reflective reports. Teaching is a prestigious profession; continuous development is mandatory.
Mentoring Support	Candidates are supported by school mentors and NIE supervisors.

Singapore's **teacher education system** is centrally organised. The National Institute of Education (NIE) oversees the entire teacher education process at both the undergraduate and graduate levels. During the four-year undergraduate program, science teacher candidates acquire subject-specific knowledge in the sciences while also developing educational skills, including pedagogical methods, classroom management, and micro-teaching. In Singapore, the practical training for science teachers is conducted through a 22-week school-based practice. The training is supported by continuous professional development; teachers are required to complete 100 hours of professional development each year. Additionally, teachers are expected to apply innovative teaching methods in their instruction. Teaching is considered a highly respected profession in Singapore, and international successes further reinforce this prestige.

Türkiye’s Science Teacher Education Paradigm

The process of training science teachers in Türkiye is carried out through institutional collaboration between the Council of Higher Education (YÖK) and the Ministry of National Education (MoNE). The structure of teacher education programs—comprising undergraduate degrees, pedagogical formation, and non-thesis graduate programs—as well as their curricula and implementation principles, is determined by YÖK. On the other hand, the appointment policies, subject area selection, and teaching responsibilities related to teaching professions are regulated by the MoNE through the Board of Education and Discipline (TTK).

There are two main institutional structures responsible for training science teachers in Türkiye: Faculties of Education and Faculties of Science and Letters. While Faculties of Education are directly responsible for teacher training, graduates of Faculties of Science and Letters are prepared for the teaching profession through pedagogical formation programs or non-thesis master's degree programs. Students are placed into these programs based on their scores from the Higher Education Institutions Exam (YKS), administered at the end of secondary education.

The science teacher education program, revised in 2018, consists of three core components: subject-matter knowledge, pedagogical formation, and practicum. The program includes pedagogy specific to the teaching of physics, chemistry, and biology, as well as experimental practices, laboratory-based instruction, and didactic strategies for teaching science. In this respect, contemporary courses that reflect the interdisciplinary and practice-oriented nature of science education have been integrated into the curriculum (YÖK, 2018).

Practice-based training is a fundamental component of the preparation of prospective teachers. In undergraduate programs conducted by faculties of education, practical components are integrated directly into the curriculum. For graduates of the Faculties of Science and Letters, practical training is embedded in pedagogical formation or non-thesis master's programs. Internships are conducted in schools affiliated with the Ministry of National Education, and teacher candidates are supervised by both a faculty advisor from the university and a mentor teacher from the school (Yener &Yılmaz, 2021).

Until 2024, the teacher appointment system in Türkiye was based on the Public Personnel Selection Examination (KPSS) and interviews. However, with the enactment of the Teaching Profession Law (ÖMK) in 2024, processes related to teacher selection, training, appointment, responsibilities, and career progression have been restructured (ÖMK, 2024). As of 2025, teacher appointments have transitioned to a new two-stage examination system comprising the Academy Entrance Examination (AGS) and the Teaching Field Knowledge Test (ÖABT). Candidates who pass the AGS are enrolled in a pre-service professional education program under the National Education Academy umbrella, which lasts approximately 2 years.

With the new system, teachers are also subject to compulsory annual professional development requirements. In cooperation between YÖK and MoNE, efforts are ongoing to restructure teacher education programs to be more practice-oriented and to develop graduate-level certification programs under the AGS framework. These developments indicate that Türkiye's teacher training system is evolving into a holistic structure encompassing not only pre-service but also in-service and continuous professional development processes.

Table 8

Science Teacher Education System in Türkiye

Component	Description
Official Curriculum	The teacher education curriculum is determined by the Council of Higher Education (YÖK); the Board of Education and Discipline (TTK) regulates appointment and subject allocation policies for teaching professions.
Curriculum Developers	Curricula are developed under the coordination of YÖK. Implementation is carried out by universities and executed through protocols with the Ministry of National Education (MoNE).
Science Teacher Training	The primary route is a four-year undergraduate degree at the faculties of education. Alternatively, graduates of science faculties can become teachers through pedagogical formation or non-thesis master's programs.
Curriculum Structure	Three core domains: subject-matter knowledge, pedagogical formation, and practicum. In the 2018 revision, subject courses were reduced while pedagogical courses were increased. Disciplinary science instruction and lab work are included.
Local Practicum	Practicum is integrated into undergraduate programs in education faculties. In science faculties, it is part of the non-thesis master's curriculum. The practicum duration is limited; mentoring structures are minimal and unsystematic.
Internship and Practice	The 2018 program mandates two semesters of practicum: • School Experience (2+2 hours) • Teaching Practice (2+6 hours). These take place in MoNE-affiliated schools.
Quality Assurance	Until 2025, teacher appointments were based on KPSS and interviews. As of 2025, AGS and ÖABT are required. Candidates who pass AGS undergo a two-year training program. Career and competency pathways were restructured via the 2024 Teaching Profession Law.
Mentoring Support	University advisors and school mentors oversee the practicum; however, the mentoring system lacks standardisation and data support. In the new system (AGS), mentoring is being structured into the post-graduate teacher education process.

The teacher education process for science teachers in Türkiye is carried out through collaboration between the Higher Education Council (YÖK) and the Ministry of National Education (MoNE). Teacher candidates undertake a four-year undergraduate program, during which they receive courses in subject knowledge, pedagogical formation, and practical training. Graduates from the Faculty of Science and Literature prepare for the teaching profession through pedagogical formation or non-thesis master's programs. In **Türkiye**, the practical training process typically involves internships and teaching practices; however, the structure is limited in terms of mentoring and the duration of practical experience. Teacher appointments in **Türkiye** are generally made through the Public Personnel Selection Examination (KPSS) and interviews. Still, with the enactment of the Teacher Employment Law (ÖMK) in 2024, the appointment process has been reformed, introducing a two-stage examination process involving the Academy Entry Exam (AGS) and the Teaching Profession Knowledge Exam (ÖABT). Under the new system, teachers are required to engage in continuous professional development.

The teacher education systems for science teachers in the four countries above have been examined in detail, and key elements of each country's educational processes have been presented. To more clearly observe the common and differing aspects of these systems, the countries are now presented in a single table below.

Table 9
Teacher Education Systems for Science Teachers in Finland, Singapore, South Korea, and Türkiye

Elements	Finland	Singapore	South Korea	Türkiye
Official Curriculum	Science teacher education curricula are determined by universities, with each institution offering its own unique curriculum.	The science teacher education curriculum is developed collaboratively by the MOE and NIE.	The science teacher education curriculum is shaped through the collaboration of universities and the Ministry of Education.	The curriculum is determined by the Higher Education Council (YÖK); the Board of Education and Discipline (TTK) regulates appointment criteria.
Curriculum Developers	Universities (mainly the University of Helsinki).	Developed collaboratively by the National Institute of Education (NIE) and the Ministry of Education (MOE).	Developed through the collaboration of the Faculties of Education, the Faculties of Science and Literature, and the Ministry of Education.	Developed collaboratively by YÖK and MoNE; implemented by universities.
Teacher Education Program	Teacher candidates complete a 5-year undergraduate program that includes pedagogical formation and science field courses.	Science teacher education is offered at two levels: BSc(Ed) program (4 years) and PGDE (16 months).	After undergraduate education, pedagogical training is provided; specialized training for teaching is given.	4-year undergraduate program at Faculty of Education; graduates from Faculties of Science and Literature receive pedagogical formation.
Module Structure	Science field courses, pedagogical content, teaching strategies, and application-oriented studies.	Science content courses, pedagogical methods, micro-teaching, and classroom management.	Discipline-based education (physics, chemistry, biology), and pedagogical teaching methodologies.	Subject knowledge, pedagogical formation, laboratory applications, and teacher profession knowledge.
Local Application	School-based practice is mandatory; teaching and learning are continuous.	School-based practice and teaching experience with mentoring support in schools.	Teaching practice is conducted in schools under the guidance of university advisors and school mentors.	Application-based education in schools; teacher candidates are supported by school counsellors and university advisors.
Internship and Practice	Students engage in school-based practice for 3 -5 years as part of their education.	22 weeks of school-based practice during the BSc(Ed) program and 10 weeks during the PGDE program.	Teacher candidates work as trainee teachers in schools; specific school-based practices are conducted for a set period.	Mandatory school experience for two semesters during undergraduate studies, with teaching practice.

Table 9 - continued

Elements	Finland	Singapore	South Korea	Türkiye
Quality Assurance	In-school monitoring and evaluation are conducted to support teachers' continuous development; this support continues after graduation.	Rigorous evaluations conducted by NIE and MOE, alongside continuous professional development courses.	Performance evaluations, seminars, and workshops are organised for continuous development.	Teacher careers are determined through KPSS and interviews; a new examination system will be implemented in 2025.
Mentoring Support	It is traditional for each teacher candidate to receive mentorship from experienced teachers.	Students receive mentorship at school, while NIE provides academic advising.	School counsellors and university advisors monitor and support teacher candidates.	University advisors and school counsellors provide mentorship. However, this system is not systematic.
Selection Process	High academic achievement is required for teacher training; admission to the program is competitive.	Teacher candidates must have high A-Level performance; applications are highly competitive.	Entrance exams and personal competence assessments are required. Highly competitive exams are applied	Students are placed in teaching programs based on high scores; appointments are made through KPSS and interviews.
Professional Development	Teachers are required to participate in continuous professional development courses.	Each teacher must attend 100 hours of professional development courses per year.	Annual programs for continuous development are organised, and teachers are required to attend courses.	Continuous professional development is mandatory for teachers; professional education begins after the AGS and ÖABT exams.

The teacher education systems for science teachers in Finland, Singapore, South Korea, and Türkiye share many common characteristics. In each country, science teacher education programs emphasise the balanced delivery of scientific content and pedagogical knowledge. Teacher candidates develop their professional skills through classroom experience in real school settings. Additionally, mentoring support is provided in all countries, experienced teachers and academic advisors guide teacher candidates. Continuous professional development is mandatory in all countries, with teachers able to improve their skills through various training sessions and seminars throughout the year. The selection processes in each country are highly rigorous, and teacher candidates are expected to possess high academic achievement.

There are notable differences in the teacher education systems across these countries. While Finland provides teacher education curricula independently through universities, in other countries, this process is determined and supervised by central authorities. Teacher education in Finland lasts 5 years, whereas in Singapore, teacher candidates complete a 4-year undergraduate program followed by a 16-month Postgraduate Diploma in Education (PGDE). In South Korea and Türkiye, teacher candidates are required to complete pedagogical formation or additional master's programs. The curricula also vary: Finland focuses on teaching strategies and critical thinking skills, while Singapore emphasises laboratory-based teaching and scientific argumentation. In South Korea, a discipline-based approach is adopted, whereas in Türkiye, both subject knowledge and science didactics are of great importance.

Selection and evaluation processes also differ across countries. In Türkiye, applications for the teaching profession are made through centralised, bureaucratic processes such as the KPSS and interviews, while in Singapore and South Korea, the application process is more competitive, requiring high academic achievement and personal competence. In Finland, although the teacher selection process is rigorous, the application process is more open to a broader pool of candidates. In Türkiye, becoming a teacher not only requires completing the education process but also undergoing a long and challenging appointment process. This process involves passing through tough stages such as the KPSS and interviews, and often waiting for years to be appointed.

There are also significant differences in terms of professional development. While Singapore organises mandatory courses and seminars to support teachers' continuous education, Finland promotes autonomy in teachers' professional development and encourages individual growth. In Türkiye, professional development is typically shaped through limited courses and specific exams.

4. Inferences of the Teacher Education Paradigms of High-Performing Countries in Science for Türkiye

The teacher education systems in Finland, Singapore, and South Korea, which are high performing in science, offer significant lessons for Türkiye. The selection of teacher candidates, educational programs, teacher autonomy, and professional development processes in these countries can serve as valuable references for improving Türkiye's teacher education system.

A common characteristic among the three successful countries is the highly selective and competitive process for entering the teaching profession. In Finland and South Korea, teacher candidates are assessed not only through university entrance exams but also through written exams, aptitude tests, and interviews, enabling a more comprehensive evaluation of their suitability for the profession (Sahlberg, 2010; Can Aran & Derman, 2020). In contrast, in Türkiye, admission to teacher education programs is based solely on national exam results, creating a narrower selection process for the teaching profession. Furthermore, in the high-performing countries, the high status and economic attractiveness of the teaching profession enhance teachers' motivation and job satisfaction (Sahlberg, 2010; Demirel Yazıcı & Cemaloğlu, 2022). In Türkiye, however, teacher salaries remain below the OECD average, and the relatively small pay differential between novice teachers and those with twenty years of experience reduces the profession's economic appeal and adversely affects long-term professional motivation.

The structure of the education programs also shows marked differences among the countries. Finland extends its teacher education process over five years, allowing teacher candidates to reinforce their theoretical knowledge through practical experience (Niemi & Lavonen, 2020). Singapore and South Korea, on the other hand, offer intensive training programs within a shorter time frame, preparing teacher candidates effectively but in a condensed period (NTU, 2023; MOE, 2025). In Türkiye, teacher education programs generally last four years, and with limited practical training, teacher candidates are unable to develop their pedagogical skills fully. Moreover, a substantial proportion of final-year students in education faculties devote much of their attention and energy to preparing for the KPSS (Public Personnel Selection Examination), thereby significantly diminishing the effectiveness of their school experience and teaching practice courses. This highlights the need to strengthen the link between teaching practice and theoretical education.

Teacher autonomy is another key point of distinction. Teachers in Finland, owing to their high-level education, enjoy significant autonomy and have the right to select their own curricula, teaching methods, and learning materials (Niemi & Lavonen, 2020). In Singapore and South Korea, although teachers work within certain boundaries, they still have important decision-making powers to enhance the quality of education NTU, 2023; MOE, 2025). In Türkiye, teachers tend to assume a more implementation-oriented role and have limited decision-making authority over educational content. Moreover, the centralised structuring of teacher education programs by the Council of Higher Education (YÖK) imposes constraints on institutional autonomy for universities and faculty members. This situation can indirectly hinder the development of teachers' professional autonomy and may negatively affect both job satisfaction and the feasibility of implementing innovative educational approaches.

Continuous professional development processes also differ across countries. In South Korea and Singapore, teachers are required to undergo mandatory in-service training within specific timeframes, and their performance in these trainings influences their promotion and salary increases (Jeong, 2020; NTU, 2023). In Finland, however, teachers are given the opportunity to determine their own professional development paths, with a strong emphasis on independence and autonomy (EDUFI, 2022). In Türkiye, the professional development opportunities for teachers are more limited, and the need for a continuous educational process in this area is emphasised.

Lastly, equity of opportunity and addressing individual differences in education are fundamental elements of successful teacher education systems. Finland prioritises equal educational opportunities and the meeting of individual needs (Sahlberg, 2011), while in Türkiye, socio-economic disparities between schools result in significant differences in the quality of education. Insufficient school facilities and difficult geographical conditions, particularly in rural areas, can negatively affect teachers' motivation. This situation exacerbates teacher shortages and regional inequalities, further increasing educational disparities.

4. Conclusion and Discussion

When examining the education systems of countries with the highest performance in science literacy according to PISA results, it becomes evident that there are significant differences in their approaches to teacher education. Each country adopts teacher policies and practices that align with its unique societal and institutional context. However, when PISA and TALIS data are evaluated together, it is suggested that teachers' professional competencies and the overall quality of teacher education systems have a decisive impact on student achievement. Indeed, the *Science Teachers' Satisfaction* (STS) thematic report (OECD, 2018), based on the TALIS study, identifies a positive relationship between students' science achievement and teachers' satisfaction with both the profession and their current positions. Moreover, non-cognitive student outcomes such as enjoyment of science lessons and sense of school belonging are significantly associated with teachers' job satisfaction. The fact that these relationships remain valid even after controlling for teacher demographic profiles increases the reliability of the findings (Mostafa & Pál, 2018).

Mentorship is a critical component supporting the professional adaptation of novice teachers. In Singapore, such support is institutionalised through a systematic induction and mentoring architecture, with participation rates (30%) exceeding the OECD average (22%). TALIS 2018 data reveal that such structural support significantly enhances novice teachers' self-efficacy and classroom practices (OECD, 2019; 2020). In contrast, mentorship support is quite limited in countries like Finland (6%), Türkiye (8%), and Korea (10%), where support is often dependent on school-level initiatives or informal relationships. This makes scalable quality assurance more challenging (OECD, 2019; 2020). Although mentorship in Finland is weak, its strong master's programs and practice school model compensate for this gap. In Korea, despite the presence of a centralised professional development culture, induction support appears to be insufficiently institutionalised. In Türkiye, the previous teacher training system lacked structured mentorship and had limited practicum periods. However, with the recent implementation of the *Academy Entrance Examination* **(AGS)**, mentoring has been restructured and is gradually becoming institutionalised within the post-graduation education phase (ÖMK, 2024). Although current rates remain low, the recently introduced candidate teacher systems are considered significant steps toward addressing this gap (MoNE, 2017).

Participation in professional development is high across all countries (>90%). While this appears quantitatively promising, TALIS 2018 emphasises the importance of **quality**—that is, collaborative, practice-oriented, and sustained professional learning (OECD, 2019). In Singapore and Korea, the close integration of professional development with career progression helps transform high participation into improved classroom practice (OECD, 2020). Although participation rates are also high in Türkiye and Finland, TALIS reports highlight a mismatch between the areas where teachers express the most need (e.g., ICT, multicultural classrooms, special needs students) and the content of the professional development they receive (OECD, 2019).

One of the activities that consumes the most teacher time is lesson planning and preparation (inside or outside school). Across the OECD, teachers spend an average of 6.5 hours per week on preparation, while in Türkiye this figure is only 2.5 hours—well below the OECD average. TALIS data suggest that time allocated to out-of-class pedagogical tasks (e.g., planning, assessment, material development) is linked to instructional quality, whereas increased administrative burdens reduce the time available for such activities (OECD, 2019; 2020). In countries like Singapore (8 hours) and Korea (7 hours), longer preparation time is supported by dedicated time blocks and school-based collaborative practices, such as a shared planning culture (OECD, 2020).

Weekly working hours in Singapore (32 hours) and Türkiye (30 hours) are above the OECD average (29 hours). TALIS 2018 reports that as teachers spend more time on non-instructional tasks—such as paperwork, administrative duties, and student-related work—their stress levels increase and job satisfaction declines (OECD, 2020). Korea's relatively low working hours (26 hours) are attributed to more explicit role definitions and stronger administrative support (OECD, 2020). Finland, at 28 hours, aligns closely with the OECD average; however, the Finnish culture of teacher autonomy and protected planning time qualitatively distinguishes how these hours are used (OECD, 2019).

Linguistic diversity requires teachers to possess differentiated skills in classroom management, material selection, and assessment. In Singapore, a notably high proportion of teachers (80%) work in multilingual/multicultural contexts, underscoring the critical importance of differentiated instruction, inclusive pedagogies, and linguistic support strategies in both pre-service and in-service training (OECD, 2019). Türkiye, with 22%, is close to the OECD average; however, recent migration trends suggest that teachers—particularly in major cities—are increasingly operating in multilingual environments compared to the TALIS 2015 cycle (OECD, 2020). In Finland and Korea, lower rates (18% and 2%, respectively) may reduce perceived need for professional development in this area (OECD, 2019).

In terms of using ICT in classroom projects, Türkiye ranks above the OECD average (67% vs. 53%), suggesting that teachers are generally willing to integrate technology into student-centred activities. However, TALIS cautions that frequent use of ICT alone does not guarantee pedagogical impact; effective integration with cognitive activation and student-centred strategies is essential (OECD, 2019). The relatively lower figures in Korea and Singapore, despite their advanced technological infrastructure, may reflect a more exam-oriented, traditional system, showing caution toward project-based and student-led pedagogies (OECD, 2020). Finland's average rate may be linked to teacher autonomy and school-level decision-making regarding technology use (OECD, 2019).

Singapore stands out with an exceptionally high rate of 88% in terms of teachers having received ICT training, indicating the presence of nationally structured technology pedagogy programs (OECD, 2019). While Türkiye exceeds the OECD average (56%) with a rate of 71%, this is a positive development; however, this figure should be evaluated alongside whether such training translates into classroom practice and the overall competence of teachers in technology pedagogy. TALIS reports emphasise that these training sessions should be practice-oriented and supported by in-class mentoring (OECD, 2020). The moderate performance of Finland and Korea may suggest the existence of models in which technology integration is more dependent on school/teacher autonomy or nurtured through informal learning (OECD, 2019).

Regarding teachers' self-efficacy in ICT, both Türkiye (61%) and Singapore (60%) significantly exceed the OECD average (43%). TALIS data reveal that ICT self-efficacy is associated with both participation in ICT-related training and the frequency of pedagogical use of ICT in classrooms (OECD, 2019; 2020). The low perception rate in Finland (21%) may be explained by teachers' preference for a critical and measured use of technology or by a cultural tendency toward high-standard self-assessment (i.e., setting a high bar before declaring oneself competent) (OECD, 2019). Korea's upper-middle level (48%) may also reflect a similarly cautious self-evaluation culture (OECD, 2020).

Türkiye's high level of teacher self-efficacy in classroom management (90%) emerges as a significant strength. OECD reports demonstrate that classroom management self-efficacy reduces teacher stress levels and increases instructional time, i.e., the net time allocated to learning (OECD, 2019). Singapore's relatively lower figure in this area (79%) may be linked to pedagogical approaches that emphasise student autonomy, which diverge from traditional perceptions of classroom management and thus lead to different self-assessments (OECD, 2020). The rates in Finland and Korea (82%) appear consistent with the favourable disciplinary climate and student behavioural regulations in these countries (OECD, 2019).

Teacher satisfaction in Singapore and Korea can be associated with *high* levels of job satisfaction, the social prestige of the teaching profession, the clarity of career pathways, and the systematic nature of professional development opportunities (OECD, 2020). In contrast, the *moderate* levels of job satisfaction reported in Finland and Türkiye highlight the need for improvement in areas such as workload, salary and promotion structures, participation in decision-making, and support from school leadership (OECD, 2019; 2020). TALIS 2018 data clearly demonstrate that sources of stress, such as administrative workload, behavioural management challenges, and time pressure, negatively affect job satisfaction (OECD, 2020). Professional satisfaction is a critical indicator that affects teachers' work engagement, retention in the profession, and levels of burnout. Türkiye's moderate level of job satisfaction underscores the need to address structural issues, particularly in areas such as career progression, salary policies, and relations with school administrators. Teacher satisfaction remains a prominent issue for education systems that struggle to attract and retain qualified educators. The optional teacher questionnaire, implemented for the first time in PISA 2015 and distributed in 19 countries, provided valuable data on teachers' satisfaction with their profession and their work. While PISA's strength lies in its capacity to analyse student, school, and teacher contexts comparatively, the use of non-experimental and cross-sectional data limits the ability to establish causal links between teacher satisfaction and environmental factors, even when advanced statistical methods are applied (Mostafa & Pál, 2018).

Choosing teaching as a first career preference is directly related to teachers' professional commitment and motivation. In this regard, Korea's very high proportion (80%) of teachers who selected teaching as their first choice reflects the profession's social prestige and the country's highly selective teacher education system (OECD, 2020). By contrast, Finland's rate of 59%, which falls below the OECD average (66%), is noteworthy; this may be associated with the demanding academic nature of the teaching profession in the country, which typically requires a master's degree (OECD, 2019). Although data for Türkiye and Singapore are lacking, making direct comparisons difficult, TALIS and other OECD studies clearly indicate that policies regarding the selection and education of teacher candidates play a determining role in shaping the prestige and attractiveness of the profession. The academic qualifications required for entry into the teaching profession vary significantly across countries and have a direct impact on teacher quality. In OECD countries, the vast majority of teachers have at least a bachelor's degree (ISCED 6), and in some cases, this extends to the master's level. Finland exemplifies this with 85% of its teachers holding a master's degree, positioning teaching as an academically demanding and professional career (OECD, 2019). This suggests that entering the profession with high levels of academic preparation contributes to improved teacher quality. In Türkiye, while 92% of teachers hold a bachelor's degree, only 7% possess a master's degree. This highlights the need to expand in-service master's programs and research-based practices (OECD, 2019). The OECD average of 33% for teachers holding master's degrees suggests that many systems regard the bachelor's degree as the minimum entry standard, which creates pressure to enhance post-graduation professional development (OECD, 2020). In high-performing countries in PISA, teacher education typically spans four years, indicating that the duration and level of initial teacher education programs—typically long and at the undergraduate level—are closely linked to quality (TALIS, 2018).

While an overall positive picture emerges regarding participation in professional development, quantitative data alone are not sufficient; the quality of professional learning activities is at least as important as participation rates. Although the high level of participation in professional development activities among teachers in Türkiye is a positive indicator, the fact that these activities are predominantly seminar-based may limit the effectiveness of the professional development process (Özerbaş & Safi, 2022). According to the OECD average, the most commonly attended forms of professional development by teachers are: face-to-face courses and/or seminars (75%), educational conferences (48%), observation or coaching as part of formal arrangements (43%), participation in professional teacher networks (40%), online courses and/or seminars (36%), and other professional development activities (32%). Although country-specific details in TALIS data are limited, it is emphasised that in Singapore, the participation rate in face-to-face courses/seminars exceeds 90%. In both Singapore and South Korea, teacher participation in professional networks exceeds 65% (OECD, 2020).

In summary, **Finland**, where teachers receive master's level education and teacher autonomy plays a significant role in education, offers a system that shows high respect for teachers both personally and professionally. Teaching is regarded not just as a job but as a prestigious academic career. In **Singapore**, the high standards of education, the academically rigorous and meticulous teacher training system, and the provision of continuous professional development opportunities for teachers contribute to the success of the country's education system. Additionally, the high social prestige of teachers and strong support for career development enhance professional motivation. In **South Korea**, where teachers are highly respected and enjoy high job satisfaction, the teacher training process is academically selective and demanding. South Korea's education system is reinforced by structures that consistently support teachers' professional development. Moreover, strong school leadership and teacher collaboration further support this success.

Overall, the findings suggest that embarking on a teaching career as a purposeful goal, the presence of a collaborative working environment, adequate human and physical resources, and the availability of professional development opportunities are strongly associated with student achievement and attitudes, as well as teacher satisfaction. For individuals who aspire to become teachers after completing their education and training programs, science teaching is not only a profession but also a realisation of personal goals (Mostafa & Pál, 2018).

Science teacher education programs aim to integrate content knowledge, pedagogical knowledge, and professional skills (Shulman, 1986). However, science teacher education programs in Türkiye still exhibit developmental needs, particularly in integrating theoretical knowledge with practical experience and advancing pedagogical content knowledge (PCK) (Belge Can, 2019; Canbazoğlu, Demirelli & Kavak, 2010). Deficiencies in classroom-based practice, insufficient integration of technology, and the lack of institutionalised mentoring systems limit the development of pre-service teachers' professional competencies. Although interdisciplinary approaches and the use of digital teaching materials have become more prominent in recent years, broader, more systematic reforms are needed to mainstream these innovations (Ataman & Orhan, 2024; Gess-Newsome et al., 2019; Koyuncu, 2025).

High-quality teachers are the cornerstone of educating competent students, thereby improving student achievement. Teacher quality is shaped by the effectiveness of teacher education programs and the overall quality of the education system, whereas teacher satisfaction is closely linked to working conditions, opportunities for professional growth, and collaborative, supportive environments. Although these two elements are distinct, they are complementary and deeply interconnected. High teacher satisfaction enhances teachers' motivation and professional commitment, thereby positively influencing their performance and, in turn, student outcomes (Koyuncu, 2025; Mostafa & Pál, 2018; Özerbaş & Safi, 2022; Saracaloğlu & Ceylan, 2016; TALIS, 2018). In subject areas such as science education, which require specialised expertise, job satisfaction and a strong sense of professional belonging are critical for sustainable success.

The teaching profession in Türkiye faces various challenges, both in the difficulties encountered during the entry process (such as the KPSS, interviews, etc.) and in societal perceptions. Teaching is often viewed merely as the act of "delivering lessons" and carries less social prestige than professions like medicine, law, and engineering. Low salaries, demanding working conditions, and limited career opportunities further reinforce this perception. However, teachers play a critical role in directly shaping students' lives and in moulding the future human resources of society. Data from the OECD (2019) and PISA (2022) indicate that the social status and job satisfaction of teachers are closely related to the success of the education system. Therefore, increasing the societal prestige of the teaching profession in Türkiye will not only enhance teachers' motivation but also positively impact the overall quality of education (OECD, 2020).

Therefore, education policy should prioritise the development of teachers' academic and pedagogical competencies, as well as the enhancement of job satisfaction and motivation. The provision of effective mentoring systems, collaborative school cultures, high-quality professional development opportunities, and supportive working conditions will help maintain a balance between teacher quality and satisfaction, thereby making substantial contributions to the overall success of the education system and to student learning outcomes. In this regard, several recommendations can be made:

- The teaching profession should be elevated to a respected status in society, making teachers’ professional achievements and contributions more visible, while improving their material conditions.
- Educational policies should aim to enhance the economic and professional value of the teaching profession in order to encourage the most talented students to pursue a career in teaching.
- Teachers should be granted greater professional autonomy, involved in decision-making processes regarding education, and provided with continuous professional development opportunities.
- The process of entering the teaching profession should become more selective, with training programs designed to offer both pedagogical knowledge and practical experience.
- Teachers' workloads should be reduced, bureaucratic burdens minimised by school administrations, and teachers should be given more time to focus on their professional development.
- A clear and structured system for career advancement should be established, with progress based not only on experience but also on objective criteria such as professional success and continuous development.
- To encourage teachers to engage in academic research and facilitate this process, research leave and ethical approval procedures should be made more accessible.
- In particular, teachers pursuing master's and doctoral degrees should be supported in their academic endeavours, and advantages should be provided to these teachers throughout their research activities.
- Salaries for teachers assigned to disadvantaged regions should be significantly increased, and financial incentives and bonus systems should be introduced to encourage teachers to work in these areas.
- Teachers in disadvantaged regions should be offered opportunities for rapid career progression and rewards, supported by motivation-enhancing reward systems.
- Special support programs should be developed for teachers assigned to disadvantaged areas, including the provision of educational materials, mentoring, and psychosocial support.
- Teachers' opinions should be actively sought in curriculum development processes, and course content should be application-oriented and flexible.
- Flexible teaching methods and content, suitable for students' different learning styles, should be included in the curriculum.
- Technology integration aimed at developing digital skills should be supported by materials that guide teachers.

Contribution Declaration

This is a single-authored study; all contributions were made by the author.

Conflict of Interest

The author declares that there is no conflict of interest.

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