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CURRICULUM, INNOVATION AND ETHICAL PRACTICES

Editor
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İÇİNDEKİLER

CHAPTER 1

A COMPREHENSIVE REVIEW OF SCIENCE EDUCATION CURRICULA

OKAN SARIGÖZ[1]

Introduction

Science education aims to develop individuals' abilities to think based on scientific knowledge, to understand nature, and to relate scientific processes to everyday life (Bybee, 2013). Scientific literacy is of paramount importance in addressing the environmental, technological, and social challenges faced in the modern world. In this context, science teaching is not only intended to enhance academic achievement but also to nurture individuals into responsible citizens who are conscious of their roles within society (OECD, 2019).

In Turkey, the science education curriculum has been restructured in alignment with this transformation, incorporating a constructivist approach, skill-based learning outcomes, interdisciplinary connections, and student-centered methodologies (MoNE, 2018). Therefore, assessing the quality of curricula at both national and

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international levels allows for the identification of strengths as well as areas in need of improvement.

This chapter aims to provide a comprehensive analysis of science education curricula from historical, pedagogical, and comparative perspectives. It seeks to establish links with international practices and offers an in-depth evaluation. The objectives of this chapter include a multi-faceted examination of science curricula, an analysis of their historical development and current structure, and a thorough discussion of instructional approaches, content organization, and assessment systems. In addition, science education programs in Turkey will be compared with selected international examples, identifying their strengths and weaknesses to shed light on the developmental processes in this field.

- The chapter will address the following research questions:
- How have science education curricula evolved in Turkey?
- What are the fundamental components of the current science curriculum?
- Which instructional approaches and methods are emphasized within this curriculum?
- How is the student assessment process structured?
- In what ways are Turkey's science education curricula similar to or different from those in other countries?
    - What are the strengths and areas for improvement in the current curriculum?

Structured around these questions, the chapter aims to serve as a comprehensive reference for researchers, prospective teachers, curriculum developers, and policymakers interested in science education.

Historical Development of Science Education Curricula

The development of science education in Turkey has progressed in parallel with scientific and societal transformations since the foundation of the Republic. The first major step was taken with the Law on the Unification of Education (Tevhid-i Tedrisat) enacted in 1924, which introduced a centralized curriculum model. The 1948 curriculum reforms brought science education into a more systematic structure (Akyüz, 2015). In 1974, the discipline was restructured under the title of "Science Knowledge" with an interdisciplinary orientation, and the 1997 curriculum updates marked the initial steps towards a constructivist approach. The most comprehensive reform took place in 2005, when the constructivist learning theory was officially adopted (Çepni et al., 2006). The subsequent updates in 2013 and 2018 further strengthened the curriculum by integrating 21st-century themes such as STEM education, digital literacy, and sustainability (Sönmez & Demirtaş, 2020). The evolution of the curriculum has brought significant changes not only in content but also in instructional methods, assessment practices, and teacher roles (Cengiz et al., 2015).

The historical trajectory of science education curricula has been shaped by educational policies as well as advancements in science and technology (Sarıgöz, 2014). In Turkey, science education has been regarded as a vital component of modernization efforts following the proclamation of the Republic. Throughout different periods, major curriculum reforms have been implemented. With the Law on the Unification of Education (1924), the education system was centralized, and science subjects were established as core components of the national curriculum. During this period, the curriculum was primarily based on direct transmission of knowledge. Science education was conducted through sub-disciplines such as biology, physics, and chemistry, with limited

emphasis on experimental activities—favoring a classical, rote-learning model.

The 1948 curriculum reforms introduced a more structured model of science education. Greater emphasis was placed on laboratory work, and students were encouraged to acquire knowledge through observation and experimentation. Efforts to increase the availability of instructional materials and to improve teacher training contributed to the overall quality of science education. In 1974, a significant reform integrated various science subjects under the umbrella of "Science Knowledge" at the primary education level. Disciplines such as physics, chemistry, and biology were unified into a single course and presented in a more accessible manner, linking content to everyday life. This period also saw the early traces of student-centered teaching approaches.

The 1997 curriculum revisions laid the foundations for a constructivist teaching model, leading to a transition towards more active and participatory learning processes (Sarıgöz, 2008). This era also witnessed the introduction of technology-supported instructional materials and the implementation of contemporary learning theories such as Gardner's theory of multiple intelligences.

In 2005, the Ministry of National Education launched a new science and technology curriculum that was explicitly grounded in constructivist learning theory. This reform adopted a student-centered, skill-based, and experience-oriented approach. Concepts such as scientific process skills, environmental awareness, and inquiry-based learning were placed at the core of the curriculum. It also triggered substantial changes in teacher training and textbook development. The 2013 revision enhanced interdisciplinary connections and emphasized competencies such as STEM literacy, digital fluency, and creative thinking. The 2018 update simplified

the language of the curriculum, restructured learning outcomes, and incorporated themes such as values education, national cultural elements, and sustainability.

Today, the development of science curricula in Turkey is progressing in synchronization with global educational trends. Key influences include international assessment frameworks (such as PISA and TIMSS), the increasing role of technology in education, the acceleration of digital transformation following the COVID-19 pandemic, and the prioritization of 21st-century skills. These factors collectively continue to shape the ongoing evolution of science education programs.

Key Features of the Current Science Education Curriculum

The most recent update of the science education curriculum by the Turkish Ministry of National Education was implemented in 2018. This curriculum is grounded in a student-centered constructivist approach and aims to enhance students' scientific process skills (MoNE, 2018). The content is structured around four main learning domains: *Living Beings and Life*, *Matter and Its Nature*, *Physical Events*, and *Earth and the Universe*. The program is designed not only to facilitate the transmission of scientific knowledge but also to foster the development of skills, attitudes, and values. Emphasis is placed on competencies such as critical thinking, collaboration, problem-solving, and environmental awareness (Bybee, 2013; NGSS Lead States, 2013). Furthermore, interdisciplinary learning, values education, and the integration of digital tools into classroom practice are considered core components of the program (OECD, 2019). In this framework, the role of the teacher is redefined — not as a transmitter of content, but as a guide in the learning process (Şahin & Yıldırım, 2017).

As of 2023, the science curriculum currently in effect has been restructured in accordance with contemporary educational paradigms and adopts a student-centered, skills-based instructional model. This curriculum aims to develop individuals' competencies in scientific thinking and problem-solving, to relate science content to everyday life, and to foster responsibility towards the environment, society, and technology. The vision of the current curriculum is to cultivate individuals who are scientifically literate, inquisitive, capable of critical thinking, and sensitive to their surroundings. In alignment with this vision, its mission is to support the development of individuals who can access scientific knowledge, use it within ethical boundaries, and possess lifelong learning skills.

Learning Domains

The curriculum is structured around four main learning domains:

1. **Living Beings and Life**: This domain encompasses biological structures and processes, the interactions of organisms with their environments, and life cycles.
2. **Matter and Its Nature**: It focuses on fundamental chemistry topics such as the structure, states, and transformations of matter, as well as chemical reactions.
3. **Physical Events**: This area includes physics-based concepts such as force, energy, motion, electricity, sound, and light.
4. **Earth and the Universe**: This domain covers topics related to astronomy, geology, natural phenomena, and global environmental issues.

These learning domains are organized to facilitate students' development of a holistic scientific understanding. Learning outcomes in the curriculum are defined not only at the knowledge level but also in terms of skills, attitudes, and values (Sarıgöz, 2016).

Students are expected not merely to learn scientific concepts, but also to engage in experimentation, model development, problem-solving, interpretation of results, and scientific explanation.

Within this framework, particular emphasis is placed on scientific process skills—such as observation, hypothesis formulation, experimentation, and data analysis—alongside critical and creative thinking, collaboration, communication, and integration with STEM disciplines.

The current curriculum also prioritizes addressing scientific knowledge within an ethical framework. Values such as respect for human rights, environmental awareness, and the use of science for the benefit of humanity are intended to be instilled in students. Furthermore, the science course is designed with an interdisciplinary structure, linking to other subjects such as mathematics, technology, environmental education, and social studies. This approach enables students to transfer knowledge and skills across various contexts.

Moreover, the curriculum aligns with contemporary requirements by encouraging the effective use of technological tools and digital resources. Students are supported in utilizing digital assessment tools, conducting experiments through simulations, accessing virtual laboratories, and learning scientific data analysis tools.

At the core of the curriculum lies the student. The teacher assumes the role of a guide, facilitating and directing the learning process. Learning environments can be differentiated according to students' interests, needs, and individual differences. This structure enhances learning retention and supports students in becoming scientifically literate individuals.

Instructional Approaches Used in Science Education Curricula

Science education is conducted through pedagogical approaches that prioritize the active involvement of students in the learning process rather than mere transmission of knowledge. Today, the constructivist approach forms the foundation of science instruction; as an extension of this approach, inquiry-based, project-based, collaborative, and technology-supported teaching models are widely implemented (Yager, 2009; Driver et al., 1994). Constructivism posits that learning is constructed upon the learner's prior knowledge and that it occurs through active participation. Accordingly, science curricula support students in learning through experience and in constructing knowledge themselves (Fosnot, 2005). Student-centered instruction, experiments, group work, and classroom discussions are among the key applications of this approach.

Inquiry-based learning is an instructional method designed to help students engage in scientific thinking processes, enabling them to ask questions, conduct investigations, and draw evidence-based conclusions, much like scientists do. In this model, students formulate questions around a scientific problem, develop hypotheses, design experiments, collect data, and analyze findings to make scientific inferences. The learning outcomes included in the science curriculum are strongly aligned with inquiry-based learning, as they require students to actively utilize scientific process skills (National Research Council [NRC], 2000). Notably, the Programme for International Student Assessment (PISA) also highlights the significance of students' inquiry, problem-solving, and evidence-based reasoning skills, recognizing them as essential components of scientific literacy (OECD, 2019).

Project-based learning, which emphasizes the development of real-world, solution-oriented projects by students, is frequently applied in STEM education. This approach allows learners to strengthen their problem-solving, time management, creativity, and

collaboration skills (Krajcik & Blumenfeld, 2006). Learning outcomes in the science curriculum such as "conducting research" and "constructing models" support the use of project-based learning. Moreover, science courses are structured to include group activities and collaborative learning processes, in which students co-construct knowledge by engaging with one another's ideas and developing shared solutions. Johnson and Johnson (1999) have emphasized that cooperative learning is effective in enhancing academic achievement.

In today's context, it is essential that science education adapt to an increasingly digital world. Virtual laboratories, simulation software, augmented reality applications, science videos, and interactive smart boards are digital tools that enrich instruction. These resources facilitate students' comprehension of abstract concepts (Zacharia & Olympiou, 2011). Additionally, gamification and experiential learning have emerged as effective strategies for enhancing student motivation in science teaching (Sarigoz, 2023). Especially at the middle school level, science-based digital games and hands-on learning activities contribute to long-term knowledge retention (Gee, 2003). The principle of "learning by doing and experiencing," which is emphasized in the curriculum, is directly aligned with these methods.

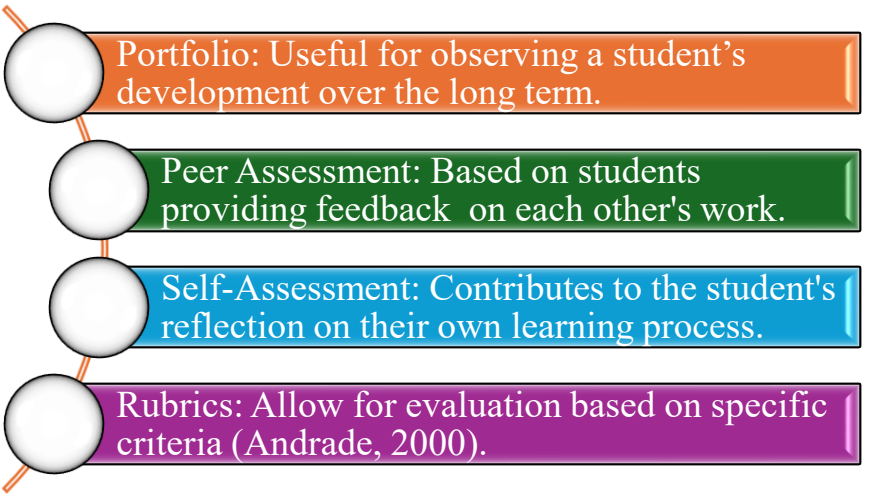
The Assessment Dimension of the Science Curriculum

Assessment is an indispensable component of science education curricula. It serves not only to measure students' levels of knowledge but also to provide tools for analyzing their scientific process skills, attitudes, values, and problem-solving competencies. The current science curriculum addresses assessment from both formative and summative perspectives (Black & Wiliam, 1998).

Formative assessment aims to monitor students' progress during the learning process, identify their deficiencies, and guide instructional practices. The science curriculum encourages the provision of continuous feedback and the regular monitoring of student development throughout the learning process (Heritage, 2007). Teachers use a variety of tools to assess this process, including observation checklists, student journals, rubrics, concept maps, and student-generated products.

Summative assessment is conducted at the end of the instructional process to evaluate the extent to which students have achieved the intended learning outcomes. This includes the use of multiple-choice tests, open-ended questions, short-answer items, project presentations, and performance-based tasks (Nitko & Brookhart, 2013). The curriculum does not define assessment solely as a numerical measurement tool, but rather as a process that reflects a student's level of scientific literacy. In science education, scientific process skills such as observing, classifying, inferring, hypothesizing, collecting and interpreting data are of critical importance. To assess these skills, instruments such as laboratory reports, project work, and structured grid-type assessments are commonly employed (Padilla, 1990).

The current curriculum also emphasizes **alternative assessment tools**, which aim to evaluate not only students' academic knowledge but also their social-emotional development, sense of responsibility, and ownership of their learning. These tools are designed to provide a more holistic understanding of student progress.



Teachers are not merely assessors but also facilitators who support learning. For an effective assessment process, teachers are expected to select appropriate tools and to analyze the results to inform and revise their teaching strategies (Stiggins, 2002). Furthermore, the quality of the assessment process is determined by the extent to which the tools employed align with the principles of **reliability and validity**.

The International Dimension of Science Education Curricula

Science education curricula vary across countries depending on their educational policies, cultural values, economic priorities, and the emphasis placed on scientific advancement. Nevertheless, the modern understanding of science education is shaped by a set of shared principles observed in many countries: scientific literacy, problem-solving skills, inquiry-based learning, environmental awareness, and interdisciplinary integration. This section provides a comparative analysis of Turkey's science curriculum alongside those of countries such as the United States, Finland, and South Korea.

In the **United States**, the *Next Generation Science Standards (NGSS)* emphasize three key components of science education: *crosscutting concepts*, *science and engineering practices*, and *disciplinary core ideas* (NGSS Lead States, 2013). Students are expected to think like scientists—gathering data and constructing explanations. Similarly, Turkey's curriculum adopts a student-centered, constructivist approach; however, it lacks the same degree of emphasis on detailed scientific practices and systematic process skills found in NGSS (Bybee, 2013). In the NGSS framework, each learning objective is holistically designed to integrate content knowledge, skills, and conceptual connections. In contrast, Turkey's curriculum often remains at the level of learning outcomes, with the degree of implementation largely dependent on the teacher's initiative (Demirdöğen & Uzuntiryaki-Kondakçı, 2016).

Finland's science education model prioritizes student well-being, research-based instruction, and integrative projects. Students learn science by relating it directly to real-life contexts. The national curriculum outlines only general objectives, while schools and teachers are granted significant autonomy to adapt content (Sahlberg, 2011). In contrast, Turkey's centralized educational system enforces a more rigid implementation framework, limiting teacher autonomy. Moreover, Finland surpasses Turkey in the physical quality of learning environments, laboratory facilities, and teacher qualifications (OECD, 2015).

South Korea consistently ranks among the top countries in PISA science literacy assessments. This success is attributed to a disciplined instructional culture and comprehensive science programs (Kang & Hong, 2008). Korean students engage in a systematic science education process from an early age, with lessons focusing on experimental learning and higher-order cognitive skills. While Turkey has increasingly emphasized experimental learning in

recent years, the practical aspects of science classes remain limited. Additionally, in terms of access to laboratory equipment and materials per student, Turkey remains at a disadvantage compared to South Korea (MoNE, 2018).

Country	Common Features	Differences
USA (NGSS)	Scientific process skills, constructivism	Multi-component learning structure, high intensity in practical application
Finland	Student-centeredness, real-life relevance	Flexible curriculum structure, teacher autonomy
South Korea	Interdisciplinary approach, emphasis on academic success	Prevalence of hands-on instruction, high level of expectations
Turkey	Constructivist approach, skill-based outcomes	Centralized structure, limited practical implementation

These comparisons demonstrate that while Turkey can continue to build upon its strengths in science education, it may also benefit from the experiences of other countries. In particular, enhancing teacher autonomy, diversifying educational resources, and expanding opportunities for practical application stand out as key areas for development.

Strengths and Weaknesses of Science Education Curricula

The evaluation of science education curricula should be conducted not only in terms of content, but also through a multidimensional lens that includes pedagogical approaches, implementation processes, assessment methods, and teacher competencies. Although

the current science education curriculum implemented in Turkey aligns significantly with modern educational paradigms, it has been subject to criticism due to various limitations observed during its practical application (Yıldırım & Altun, 2020).

The curriculum is designed with a student-centered perspective based on the constructivist learning theory. This structure, which supports learning by taking individual differences into account, promotes active learning processes (Şahin & Yıldırım, 2017). The current program aims to develop scientific process skills such as observation, data collection, hypothesis formulation, experimentation, and drawing conclusions. As a result, students do not merely acquire knowledge but also participate in the process of producing knowledge (Padilla, 1990). By linking science to other disciplines, the curriculum opens the door to the STEM approach and integrates contemporary themes such as environmental awareness, sustainability, and scientific ethics (Bybee, 2013). This enables students to connect scientific knowledge with societal issues more effectively. Moreover, the inclusion of alternative assessment tools—such as portfolios, performance tasks, and self-assessments—allows for the evaluation of students from multiple dimensions (Andrade, 2000).

However, the implementation of the curriculum is not being carried out at the desired level in many schools. In particular, shortcomings in laboratory equipment, inadequate infrastructure, and large class sizes hinder the execution of experimental activities (Türkmen, 2009). To fulfill the requirements of the program, teachers must possess sufficient pedagogical and technological competence. Yet, it has been reported that many teachers do not fully grasp the constructivist approach and that in-service training programs remain insufficient (Çepni et al., 2006). Some teachers also state that the curriculum contains an excessive number of learning outcomes,

some of which are abstract and complex in nature (Ayas et al., 2007). This creates challenges for students with lower academic achievement, making learning more difficult. Additionally, the centralized nature of the curriculum restricts teachers from adapting instruction to local needs. This rigidity may render the teaching process mechanical and limit teacher creativity (Sahlberg, 2011).

Conclusion and Recommendations

In this chapter, Turkey's science education curriculum has been examined from a multifaceted perspective, encompassing its historical development, current structure, instructional approaches, and international comparisons. The findings indicate that Turkey's science curriculum offers significant strengths in terms of incorporating contemporary pedagogical approaches and emphasizing skill-based learning outcomes. However, various structural and pedagogical challenges encountered during implementation limit the program's overall effectiveness.

Among the strengths of the curriculum are its student-centered design, focus on scientific process skills, emphasis on contemporary themes, and incorporation of alternative assessment methods. Nonetheless, shortcomings in practical implementation, insufficient teacher competencies, a centralized governance model, and inadequate infrastructure constitute major barriers to the effective execution of the program.

International comparisons—particularly with NGSS (USA), Finland, and South Korea—reveal that while Turkey's curriculum is theoretically robust, it requires further development in terms of teacher autonomy, flexibility, and opportunities for experimental learning during implementation (Sahlberg, 2011; Demirdöğen & Uzuntiryaki-Kondakçı, 2016).

In conclusion, the science curriculum in Turkey possesses the potential to meet the requirements of modern education. However, realizing this potential depends on structural reforms targeting the implementation process, the establishment of comprehensive teacher support systems, and the strengthening of school-based practical learning environments. For sustainable science education, it is imperative to adopt a holistic, flexible, and interactive curriculum framework.

- **Comprehensive in-service training programs** should be organized to enable science teachers to internalize the constructivist approach, use digital tools effectively, and master modern assessment techniques (Yıldırım & Altun, 2020).
- The content of **teacher education programs** should also be revised and updated to reflect contemporary instructional needs.
- The curriculum should be transformed into a **more flexible structure** that allows teachers to adapt content and instructional methods according to local needs. Such flexibility would increase teacher participation in decision-making processes and enhance the effectiveness of classroom practices (Sahlberg, 2011).
- The **equipment and infrastructure of science laboratories** should be improved, and the use of digital experiment simulations, augmented reality applications, and mobile laboratories should be expanded. Learning environments that allow students to learn through experimentation will directly enhance scientific literacy (Zacharia & Olympiou, 2011).
- **Alternative assessment methods** should not remain theoretical but should be actively integrated into classroom practices. Student work, portfolios, and laboratory reports should be used as process-oriented assessment tools. In this

way, not only the learning outcomes but also the learning processes themselves can be evaluated (Black & Wiliam, 1998).

- The science curriculum in Turkey can be **aligned with international standards** such as the NGSS to enhance both the content and implementation quality. Such integration would facilitate the curriculum's adaptation to global competency frameworks (Bybee, 2013).

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CHAPTER 2

AN INVESTIGATION OF THE RELATIONSHIP BETWEEN PRESERVICE TEACHERS' TEACHING STYLES AND THEIR PERCEPTIONS OF ACTIVE LEARNING: A MULTIPLE REGRESSION APPROACH

1. SERHAT SÜRAL[1]

1. Introduction

How learning takes place and how teaching environments will be designed based on this is changing in connection with the understanding of knowledge and epistemological beliefs (Kaleci, 2012). Constructivism, which is an epistemological (philosophy of knowledge) theory, has been placed at the top of the agenda in the field of education as a knowledge and learning approach (Akpınar, 2010). According to constructivist theory, learning is the process of constructing meaning by establishing a relationship between new knowledge and old knowledge and experience. Learners construct the items to be learned by associating them in their minds with what they have learned before. In this process, the learner's experience, knowledge, beliefs and expectations play a key role. In this case, the learning process is a process of uncovering previously acquired

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knowledge and an activity that enables students to actively engage with new knowledge (Connell & Franklin, 1994; Jonassen, 1994; Jonassen, Davidson, Collins, Campbell, & Haag, 1995; Fer & Cırık, 2007; Atay, 2003; Yaşar, 1998).

The features of constructivist theory affect all elements in the learning-teaching process. These effects are also seen on teachers. Constructivist teachers should be open-minded, modern, self-renewing, consider individual differences and be particularly good in their field, as well as providing appropriate learning experiences and learning together with learners, not transferring knowledge (Selley, 1999).

The teacher offers options, gives instructions, and helps each learner to make his or her own decision in accordance with the individual differences of the learners. At this point, the teacher is a facilitator and mentor. Instead of solving the problem for the learners, teachers prepare the environment for the learner to solve it. The teacher encourages learners to investigate and solve problems by asking thought-provoking questions. The teacher asks questions but does not tell the learner what or how to think. The constructivist teacher is like the north star, he/she does not tell the learner where to go but helps him/her find his/her way (Brooks & Brooks, 1999).

As can be seen, although the constructivist education approach has a student-centered structure, the role of the teacher in this process is amazingly effective. In this context, it is extremely important for teachers to constantly renew themselves, to be aware of their own competencies, to recognize their own individual characteristics, and to assume an active role in the learning and teaching process (Darling-Hammond, 2006; OECD, 2013). When these characteristics sought in the teacher come together, it can be said that the teacher determines the shape of the teaching that the

teacher performs; it can even be said that the teacher reveals his/her own teaching style (Süral, 2013).

A quality education can be realized with the presence of teachers who evaluate student achievement according to the educational process and performance based on real life and who enable students with distinctive characteristics to learn together (Townsend, 1997). The main task of the teacher for quality education is to create an effective learning environment for students (Hopkins, 1997). In a quality teaching process, teachers continuously measure students' learning with different assessment tools and methods and provide feedback (Geringer, 2003). They use different teaching and learning techniques. They make efforts to motivate students. They use student achievements as a motivational tool for learning more and help those with learning difficulties (Armutçuoğlu, 1992). They contribute to students' satisfaction with learning by giving them self-confidence, and they involve students in decisions so that they can easily express themselves by developing students' cooperative behaviors (Baştepe, 2004). The concept of teaching style emerges when the roles, behaviors, and perspectives of teachers towards students in the learning-teaching process are expressed in a common denominator. According to Grasha (1996; 2003), teaching style is a particular view of a teacher's Primary School behavior, performance, beliefs, needs and knowledge about pedagogy. These styles include teachers' instructional behaviors related to how teachers present information, how they interact with students, and how they socialize with students in the teaching-learning process. As Üredi and Üredi (2007) state, although there are many definitions of teaching style, it is seen that the point that researchers emphasize in common is "the teaching behaviors that teachers consistently show in the learning-teaching process". Teachers' preferred teaching styles shape their roles in the learning-teaching process such as conveying information to students, guiding and interacting with students.

According to Gürkan (2001), another factor affecting students' learning is how teaching is done in the Primary School and the characteristics of the teacher. In this context, it is useful to ask the following questions: "What role does the teacher assume when teaching students?", "Is the teacher in a position of authority in the Primary School or does he/she facilitate the students?", "Does the teacher prefer to give information to the students as it is?", "What methods does the teacher use while teaching?" These questions are directly related to the teaching style of the teacher. Gürkan also emphasizes that some teachers prefer to give detailed information to their students, others may exemplify information, while others may support autonomy for independent work. If teachers can analyze their students' individual characteristics well, plan their teaching-learning processes by taking these characteristics into account and offer rich options, they can educate their students in a well-rounded way. The teacher's multifaceted teaching or using the appropriate teaching style will both make the lesson more enjoyable and provide the necessary satisfaction in terms of the teacher's work. Several studies emphasize that restricting teachers to rigid instructional models is incompatible with the principles of constructivist pedagogy, which values flexibility, autonomy, and responsiveness to learners' needs (Brooks & Brooks, 1999; Saban, 2002; Fer & Cırık, 2007). Especially the teacher's use of past experiences in determining the teaching style will give the teacher a certain flexibility (Süral, 2014). When the teacher creates a learning-teaching environment in the specified way, it is an expected result that the teacher makes the students active in the lesson process. The awareness of the teacher's own teaching style will undoubtedly contribute positively to the realization of active learning in the learning environment. Several studies have emphasized that when teachers are aware of their instructional preferences and behaviors, they can more effectively apply student-centered and active learning strategies (Grasha, 1996; Felder & Brent, 1996; Darling-Hammond

et al., 2006). The dominance of active learning in the Primary School environment with the awareness of the teacher's teaching styles is a situation that can be achieved particularly in learning environments where a constructivist education approach is adopted.

According to Açıkgöz (2003), the idea of active learning is based on constructivism and its version in the field of learning, cognitivism. In line with this view, learning can be considered not as a passive reception of information but as an active process of constructing knowledge through interaction with the environment. Since knowledge is built by the learner, it becomes unique and context-dependent, rather than transferable in its entirety.

Active learning is a learning process in which the learner bears responsibility for the learning process, the learner is given opportunities to make decisions and self-regulate various aspects of the learning process, and the learner is forced to use his/her mental abilities during learning through complex instructional tasks (Açıkgöz, 2003, p.15). Active learning is the practice that includes all the work that students think about and perform (Bonwell & Eison, 1991). In another definition, active learning goes beyond the simple availability of information to enable students to discover information themselves and for subsequent performance (Butler, Phillmann, & Smart, 2001; Lake, 2000; Lonka & Ahola, 1995; Schwartz & Bransford, 1998). In the context of this study, active learning refers to the degree to which pre-service teachers adopt and value instructional strategies that engage students directly in the learning process. The Active Learning Scale used in the study includes components such as student participation, collaborative learning, problem-solving, and student responsibility. These dimensions align with constructivist approaches that emphasize learning by doing, thinking, and reflecting (Bonwell & Eison, 1991; Prince, 2004). Recent studies (Sarı, 2020; Kember & Leung, 2016) show that when

teachers actively integrate these elements, student motivation and achievement tend to improve significantly.

According to Kalem and Fer (2003), active learning is a learning situation in which students are active. It is to take the learner out of the position of passive spectator and observer and draw him/her into the learning event. However, it is not simply the participation of the learner in the learning process but encourages the learner to use his/her mental abilities, to think, to comment on the information learned, and to make relevant decisions in the learning process. The learner is actively involved in the learning process, directing his/her own learning, using higher thinking and decision-making skills and cooperating with other learners. The teacher is the one who facilitates learning in this process and learns together with his/her students.

According to Felder and Brent (1996); in active learning, teachers make students responsible for their own learning and give them the opportunity to learn on their own, so that they can apply the knowledge they have learned when they need it in daily life. It enables them to acquire skills that allow them to use them. Because in an active learning environment, learning and development are phenomena that are kept under constant control. Therefore, in active learning, the teacher is not only an authority but also a Facilitator in the Primary School (Açıkgöz, 2003).

Teaching style is defined as a teacher's characteristic approach to organizing classroom activities, delivering content, managing interaction, and guiding student learning (Grasha, 1996). Grasha's typology does not view teaching styles as mutually exclusive categories but rather as dimensions that may coexist in varying degrees within an individual. The Teaching Style Inventory used in this study includes five distinct styles:

Expert Style, teachers adopting this style are subject matter specialists who aim to convey comprehensive knowledge and expect students to assimilate it. The classroom dynamic is content-driven, and the teacher often maintains intellectual authority. Formal authority style, this style emphasizes established standards, rules, and expectations. Teachers see themselves as figures of authority and structure the classroom environment around discipline and correctness. Student autonomy is often limited. Personal model style, teachers model the behaviors and cognitive strategies they expect from their students. Learning is shaped through imitation and demonstration. The teacher acts as a role model rather than a controller. Facilitator style, this style supports student autonomy and self-directed learning. Teachers adopting this style encourage students to ask questions, reflect, and construct knowledge in interaction with others. It aligns closely with constructivist and active learning paradigms. Delegator style, teachers using this style promote peer learning, group autonomy, and responsibility. The teacher takes on a consultative role and gives students significant control over learning tasks and outcomes.

Grasha emphasized that effective teaching does not depend on rigidly adhering to a single style but rather on dynamically adjusting styles according to learners' needs and classroom contexts. Studies have shown that Facilitator and Delegator styles tend to foster higher levels of student engagement, active learning, and critical thinking (Heimlich & Norland, 2002; Cano-García & Hughes, 2000). Conversely, Expert and Formal Authority styles are associated with more content-centered, teacher-controlled environments that may not always align with the principles of active learning (Felder & Silverman, 1988).

In the field of teacher education, it is crucial to understand not only how teachers teach, but also how their instructional

preferences align with contemporary learning approaches such as active learning. While numerous studies have explored pre-service teachers' attitudes towards active learning or investigated their learning styles, limited research has focused specifically on the relationship between their teaching styles and perceptions of active learning. This gap is particularly significant given that teaching style plays a critical role in shaping classroom practices and determining whether student-centered strategies like active learning can be effectively implemented.

By examining this relationship through a multiple regression model, the present study offers a data-driven understanding of which teaching styles serve as predictors of active learning perception among pre-service teachers. The findings can inform the design of teacher education programs by identifying which instructional tendencies are more conducive to fostering active learning. Furthermore, the study contributes to the limited body of literature that bridges teaching style theory and active learning applications, especially within the Turkish context and among pre-service teachers from diverse subject areas. This multidimensional perspective provides valuable insights for both researchers and practitioners aiming to promote student-centered pedagogies in future classrooms.

The ability of teachers to apply active learning in their classrooms effectively, and to create environments that allow students to use active learning techniques correctly, is strongly associated with the teacher’s capacity to reflect on their own instructional performance and to be aware of their dominant teaching styles (Felder & Brent, 2009; Jonassen, 1999; Darling-Hammond et al., 2006). Although active learning has become a central theme in modern pedagogy, many studies have focused predominantly on student-related variables such as learning styles, motivation, and

engagement. However, as Grasha (1996) and Felder & Brent (2009) emphasize, the effectiveness of active learning environments is closely linked to how teachers perceive and enact their instructional roles. Teaching styles, as consistent patterns of instructional behavior, shape how teachers design learning experiences. Yet, the relationship between teachers' instructional preferences and their perception of active learning remains underexplored. Understanding this link is crucial, as a mismatch between teaching style and pedagogical philosophy can hinder the effective implementation of active learning strategies (Jonassen, 1999). Therefore, this study aims to fill this gap by examining how preservice teachers' teaching styles predict their perceptions toward active learning. Based on the constructivist learning theory, the importance of this research is to examine the relationship between teachers' teaching styles and their perception of active learning and to see to what extent teaching styles influence the level of active learning perception. In this context, the main purpose of the research is to determine the predictive power of teaching styles of pre-service teachers studying at the faculty of education on their perception levels of active learning. In line with this purpose, answers to the following questions were sought:

1. What is the distribution of preservice teachers' teaching styles according to gender, grade and department?

2. Do pre-service teachers' teaching styles differ according to their gender, grade and department?

3. Do pre-service teachers' perception levels of active learning differ according to gender, grade and department?

4. Is there a meaningful relationship between pre-service teachers' teaching styles and their perception of active learning?

5. Do pre-service teachers' teaching styles predict their perception of active learning?

6. What is the level of explanatory power of the regression model used in predicting the perception levels of pre-service teachers' teaching styles towards active learning in terms of adjusted R^2?

2.Method

In this section of the study, information about the research model, the population and sample numbers of the study scope, the validity and reliability study of the data collection tool and the tests used for data analysis are given.

Research Model

The research was designed as a quantitative study and the general survey model was used. In accordance with this model, it was designed with the relational survey model. Relational survey type research is a research model that aims to determine the existence and/or degree of change between two or more variables (Karasar, 2009).

Universe and Sample

The population of the study consists of students enrolled in five different teacher education programs within the Faculty of Education of a university located in the Aegean Region. These programs include Primary School Teaching, Preschool Education, Science Education, Mathematics Education, and Social Studies Education. Accordingly, 2914 pre-service teachers studying in the departments of Primary School, pre-school education, elementary

mathematics education, science education and social sciences education within the scope of the department of elementary education constituted the population of the study, while the sample number calculated according to the determined population (Balcı, 2001) was calculated as 340. To increase the reliability of the research, first, healthy data were collected from 400 pre-service teachers by exceeding the minimum sample size. Again, to increase reliability and to make the statistical data analysis more reliable, data were collected in a way that the number of pre-service teachers in 5 departments were equal. Accordingly, 80 pre-service teachers from each department were reached and a total of 400 pre-service teachers were included in the study.

Data Collection Tool and Reliability Coefficient

Within the scope of the research, the "Teaching Style Scale" developed by Grasha (1996) and adapted into Turkish by Sarıtaş and Süral (2010) was used to determine the teaching styles of pre-service teachers. Grasha Teaching Style Scale consists of 40 five-point Likert-type items with five sub- dimensions and eight items for each sub-dimension. Within the scope of this study, the "Teaching Style Scale" developed by Grasha (1996) was used. The Turkish adaptation of the scale was conducted by Sarıtaş and Süral (2010). In their study, the authors carried out both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) to ensure the construct validity of the Turkish version of the scale. The adaptation process was conducted on a sample of teacher candidates enrolled in different programs within the Faculty of Education. The reliability coefficient (Cronbach's alpha) for the overall scale was reported as .875. The sub-dimensional reliability coefficients ranged from .704 to .883, indicating a high level of internal consistency. In a separate study, Süral (2010) conducted a test–retest reliability analysis with a group of 30 lecturers proficient in English, confirming the linguistic

equivalence between the original and the Turkish versions of the items.

"Perception Scale on Active Learning" developed by Öztürk and Aydede Yalçın (2013) was used to measure pre-service teachers' perceptions of active learning. According to Öztürk (2014), in line with the data obtained because of the studies, sentences indicating the perceptions of secondary school science teachers about active learning were formed. To ensure the appropriateness of the scale for the current study group, internal consistency analysis was carried out. The Cronbach's alpha coefficient for the entire scale was found to be .891, which indicates high reliability. The sub-dimension coefficients ranged from .704 to .869, which are in line with those reported in the original adaptation study and like the values in Grasha's original work. Furthermore, previous studies in the Turkish context have successfully utilized this scale with pre-service teachers from various branches (Üredi and Üredi, 2007; Altay, 2009), supporting the scale's broader applicability. These findings collectively suggest that the scale demonstrates sufficient psychometric properties for use with the current study sample.

These sentences were then transformed into scale items. In this way, 35 draft items were created, 22 of which were positive and 13 were negative. The opinions and suggestions of 5 experts from the Department of Elementary Science Teaching, 1 expert from the Department of Curriculum and Instruction, and 2 experts from the Department of Turkish Education were taken on the 35 draft items of the "Perception of Active Learning" scale. In line with the opinions and suggestions of the experts, some items were added, some items were corrected, and some items were removed from the scale. As a result, the number of draft items organized based on expert opinion was determined as 34. After the content validity, 34 items (13 negative and 21 positive items) (Appendix 4) were

administered to 10 secondary school Science and Technology teachers as a five-point Likert-type measurement tool with positive and negative items such as "Always", "Usually", "Occasionally", "Rarely", "Never". During the application, teachers were asked about the items they had difficulty understanding, and these items were marked, and necessary corrections were made. Then, these items were administered to 230 secondary school Science and Technology teachers who were teaching in Turkey in the 2012-2013 academic year. The KMO value of the scale was found to be 0.93 and Barlett's test result was 0.000 because of the principal components analysis. Cronbach Alpha coefficient for a single factor was found to be 0.96.

Table 1. Reliability Coefficients of Grasha Teaching Styles Scale and Perception Scale for Active Learning

Teaching Style Scale (Cronbach Alpha Values)	Reliability Coefficient	
	Turkish Adaptation Study Data (Sarıtaş & Süral, 2010)	Data of the Determined Sample Group
Teacher Style Scale	,875	,891
Expert Teaching Style	,815	,785
Formal Authority Teaching Style	,768	,704
Personal Teaching Style	,708	,752
Facilitator Teaching Style	,883	,763
Delegator Teaching Style	,862	,869
	Reliability Coefficient	
Perception Scale for Active Learning (Cronbach Alpha Values)	Scale Development Study Data (Öztürk, 2014)	Data of the Determined Sample Group
Perception Scale for Active Learning	,960	,886

In the literature, it is generally accepted that a reliability coefficient of .70 or above is sufficient to indicate acceptable internal consistency in psychological measurement instruments (Tezbaşaran, 1996; Büyüköztürk, 2005). In the current study, Cronbach's alpha

coefficient of the overall Teaching Style Scale was found to be .891, while the sub-dimensions ranged between .704 and .869. These results suggest a high level of internal consistency.

Furthermore, these findings are consistent with the results obtained by Sarıtaş and Süral (2010), who conducted the Turkish adaptation of the scale and reported similar alpha values across the sub-dimensions. They also confirmed the construct validity through exploration and confirmatory factor analysis in a sample of teacher candidates. Compared to Grasha's (1996) original study conducted with in-service science teachers, the reliability coefficients in our study are slightly higher, which may be attributed to the uniformity and motivation levels of pre-service teachers as a more homogeneous group. Considering both the consistency of results with previous adaptation studies and the satisfactory reliability indicators, it is considered appropriate to use the data obtained in this study for further statistical analysis.

Data Analysis

In the analysis of gender, grade and department variables in the sample group, t-test, one-way analysis of variance (ANOVA), TUKEY tests for Post Hoc analysis, Mann Whitney U, Kruskal Wallis tests were used for non-parametric variables. Pearson Moment correlation analysis (r) was used to determine whether there is a linear relationship between pre-service teachers' teaching styles and active learning perception levels and Multiple Regression Analysis techniques were used to determine the predictive power of predictor variables (teaching styles) to predict the predicted variable (active learning perception levels). "SPSS (20) for Windows" package program was used to analyze the data.

3. Findings

In this section, the findings obtained from the data obtained from the Grasha teaching style scale and the perception scale for active learning, which were used to achieve the purpose of the study, are given.

Findings Related to the Distribution of Prospective Teachers' Teaching Styles According to Gender, Grade, and Departments

The first sub-problem analyzed within the scope of the research was formed as "How are the teaching styles of pre-service teachers according to gender, grade and department variables?". Accordingly, the frequency and percentage values of the distribution of pre-service teachers within the independent variables determined according to the teaching style that they see as the most dominant in themselves are shown in Table 2.

Table 2. Distribution of Prospective Teachers' Teaching Styles According to Gender, Grade, and Departments

	TEACHING STYLES											
	Expert		Formal Authority		Personal		Facilitator		Delegator		TOTAL	
Gender	f	%	f	%	f	%	f	%	f	%	f	%
Female	63	61.1	43	75.4	22	68.7	112	75.6	45	75.0	285	71.2
Male	40	38.9	14	24.6	10	31.3	36	24.4	15	25.0	115	28.8
Grade	f	%	f	%	f	%	f	%	f	%	F	%
Grade 1	38	36.8	20	35.1	10	31.2	32	21.6	12	20.0	112	28.0
Grade 2	30	29.1	19	33.3	5	15.6	39	26.3	18	30.0	119	29.7
Grade 3	21	20.3	12	21.1	8	25.0	31	20.9	16	26.6	91	22.7
Grade 4	13	13.8	6	10.5	9	28.2	46	31.2	14	23.4	78	19.6
Department	f	%	f	%	f	%	f	%	f	%	F	%
Primary School	6	5.8	8	14.1	6	18.7	50	33.7	15	25.0	80	20.0
Preschool Education	7	6.7	8	14.1	11	34.3	30	20.2	29	48.3	80	20.0
Science Education	30	29.1	16	28.2	8	25.0	26	17.5	10	16.6	80	20.0
Social Science Education	15	14.5	10	17.5	4	12.5	37	25.0	4	6.6	80	20.0

Primary Mathematic Education	45	43.9	15	26.1	3	9.5	15	9,6	2	4.1	80	20.0
TOTAL	103	25.7	57	14.3	32	8.0	148	37.0	60	15.0	400	100

In the first sub-problem addressed within the scope of the study, the distribution of pre-service teachers' teaching styles according to gender, grade and department variables was examined. Firstly, when the gender variable is examined, it is seen that female pre-service teachers constitute 71.2% of the sample group and male pre-service teachers constitute 28.8% of the sample group. When the grade distribution is analyzed, it can be said that the distribution of 1st and 2nd grade preservice teachers is balanced with each other, and 3rd and 4th grade pre-service teachers are balanced with each other. Finally, for the department variable, the number of pre-service teachers in five departments within the department of elementary education was equalized to obtain more reliable data, as previously explained in the determination of the study group.

In terms of teaching styles, it is seen that the highest intensity is in the guiding teaching style (f=148, %=37.0) and the lowest intensity is in the personal teaching style (f=32, %=8.0). The preferred teaching styles in the sample group are guiding, expert Delegator, formal authority and personal teaching styles, respectively.

Among female pre-service teachers, the most preferred teaching style is the guiding teaching style, while among male pre-service teachers, the most preferred teaching style is the Expert teaching style. It is a remarkable finding that the least preferred teaching style is personal teaching style for both Females and boys. Female pre-service teachers' Formal Authority (f=43) and Delegator (f=45) teaching styles and male pre-service teachers' Formal Authority (f=14), personal (f=10) and Delegator (f=15) teaching styles have remarkably close frequency values.

When the distribution of teaching styles in terms of grade variable is examined, it is seen that personal and Delegator teaching styles show a balanced frequency distribution at all four grade levels, while there is a decrease in the frequency values of Expert and authoritative teaching styles and an increase in the guiding teaching style from the first to the fourth grade. In addition, it is another remarkable finding that the most preferred teaching style among the pre-service teachers studying in the first grade is the Expert teaching style, while the highest frequency values are found in the guiding teaching style in the other grades.

When the last variable of the study, which is the department variable, is examined, it can be concluded that pre-service teachers studying in Primary School mostly prefer the guiding teaching style (f=50), while pre-service teachers studying in preschool education prefer the guiding (f=30) and Delegator teacher style (f=29), in other words, they apply a student-centered teaching. It is seen that pre-service teachers studying in science education and elementary mathematics education prefer Expert teaching style (f=30) - (f=45), which has a teacher-centered content. Finally, it is seen that the preferred teaching style of pre-service teachers studying in social studies education, like pre- service teachers studying in the departments of Primary School and preschool education, is the guiding teaching style.

Findings Related to the Differentiation Levels of Prospective Teachers' Teaching Styles According to Gender, Grade, and Departments

The second sub-problem examined within the scope of the research was formed as "Do the teaching styles of pre-service teachers differ according to gender, grade and department variables?". Accordingly, firstly, the Kolmogorov-Smirnov test was

applied to the 3 independent variables to determine whether they showed normal distribution.

The Kolmogorov-Smirnov (K-S) test examines whether the data obtained from a sample shows a normal distribution. If it shows normal values, parametric tests are used, if not, non-parametric tests are used. If the "p" value is significant at 0.05 level ($p<0.05$), non-parametric tests should be used; if $p>0.05$, parametric tests should be used (Baştürk, 2010, p.89). It was concluded that the gender variable among the independent variables showed parametric distribution because the p value was higher than 0.05, while the Grade and department variables showed non-parametric distribution because the p value was lower than 0.05.

Table 3. Differentiation Levels of Preservice Teachers' Teaching Styles According to Gender Variable

Teaching Styles	Gender	f	$\bar{x}$	Ss	t	p
Expert	Female	63	41.22	2.145	1.852	.005*
	Male	40	41.78	3.479		
Formal Authority	Female	43	33.60	3.179	2.797	.158
	Male	14	27.04	3.780		
Personal	Female	22	39.71	2.134	1.552	.099
	Male	10	35.25	1.910		
Facilitator	Female	11	39.70	2.309	2.555	.000*
	Male	36	37.50	2.224		
Delegator	Female	45	31.07	3.769	1.711	.037*
	Male	15	31.44	3.477		

In the second sub-problem of the study, firstly, when the t-test data were analyzed to see whether the gender independent variable created a differentiation on the teaching styles of pre-service teachers, it was seen that the gender variable created a significant difference in the expert, facilitator and delegator teaching styles,

while it did not create a significant difference in the formal authority and personal teaching styles.

When the gender variable is analyzed within the Expert teaching style, it is seen that male pre-service teachers ($\bar{x}$ =41.78) have a higher mean than female pre-service teachers ($\bar{X}$ =41.22). In other words, it can be said that even if there is an exceedingly small difference, it can be concluded that male pre-service teachers prefer Expert teaching style more than female pre-service teachers.

In the other teaching style, the Facilitator teaching style, where a significant difference was observed, the opposite finding was found. According to Table 3, the mean of female pre-service teachers ($\bar{X}$=39.70) was higher than the mean of male pre-service teachers ($\bar{X}$=37.50) in the Facilitator teaching style, which has a student-centered feature; accordingly, it can be interpreted that the Facilitator teaching style is a more dominant teaching style for Females than boys.

It is noteworthy among the findings of the research that male pre-service teachers have a higher average in the mentor teaching style, which is another teaching style that has a student-centered teaching style feature, than female pre-service teachers. Accordingly, it was found that male pre-service teachers ($\bar{X}$ =31.44) preferred the Delegator teaching style more than female pre-service teachers ($\bar{X}$ =31.07).

Table 4. Differentiation Levels of Preservice Teachers' Teaching Styles According to Grade Variable

Teaching Styles	Grades	f	Mean	DF	X^2	p	Difference
Expert	Grade 1	38	27,43	4	14.282	.000*	1-4, 2-4, 3-4,
	Grade 2	30	22,04				

	Grade 3	21	18,93				
	Grade 4	13	13,55				
Formal Authority	Grade 1	20	19.66	3	13.587	.158	-
	Grade 2	19	20.07				
	Grade 3	12	16.55				
	Grade 4	6	11.57				
Personal	Grade 1	10	11.57	4	12.220	.094	-
	Grade 2	5	9.88				
	Grade 3	8	10.08				
	Grade 4	9	10.21				
Facilitator	Grade 1	32	27.58	5	15.074	.000*	1-4, 3-4
	Grade 2	39	30.07				
	Grade 3	31	29.88				
	Grade 4	46	36.52				
Delegator	Grade 1	12	15.88	4	13.414	.034	2-3
	Grade 2	18	17.96				
	Grade 3	16	16.25				
	Grade 4	14	15.75				

*Significant at $p<0.05$

Since the coefficient obtained because of the Kolmogorov-Smirnov test applied to the Grade variable was less than .05, Kruskal Wallis analysis, one of the non-parametric tests, was applied to the total data obtained from the sample group. According to the results of the analysis, it was determined that there was a statistically significant difference between the groups within the grade variable and some teaching styles of pre-service teachers. These are knowledge transmitter teaching style (X^2 (4) = 14.282; $p<0.05$), Facilitator teaching style (X^2 (5) = 15.074; $p<0.05$) and Delegator teaching style (X^2 (4) = 13.414; $p<0.05$).

The Mann-Whitney U test was used to determine which groups these differences were between and is shown in Table 3.4. Each grade level is symbolized with a number. Accordingly;

(1) Grade 1 (3) Grade 3
(2) Grade 2 (4) Grade 4

To determine which group or groups these differences are between Mann - Whitney U test was applied in paired groups. The SPSS program does not perform a Post Hoc procedure to show the difference between groups because of Kruskal-Walli's analysis and between which groups this difference is between. To see the difference between these groups, the Mann - Whitney U test is applied to the groups in pairs (Baştürk, 2010).

Table 5. Analysis of Differences Between Groups

Teaching Styles	Differences	Grades	f	Row Total	Rank Mean	U	Z	p
Expert	1-4	Grade 1	38	823,0	49,18	393,0	-1,201	,020
		Grade 4	13	817,0	29,88			
	2-4	Grade 2	30	809,5	46,71	350,5	-1,638	,011
		Grade 4	13	834,5	33,14			
	3-4	Grade 3	21	858,5	39,96	388,5	-1,718	,010
		Grade 4	13	839,5	32.55			
Facilitator	1-4	Grade 1	32	821.0	41.52	369.0	-1.252	.007*
		Grade 4	46	896.0	46.85			
	3-4	Grade 3	31	821.5	39.58	385.5	-1.503	.036*
		Grade 4	46	877.5	47.55			
Delegators	2-3	Grade 2	18	820.5	31.02	387.0	-1.441	.003*
		Grade 3	16	863.0	33.50			

When Table 5 is examined, significant differences are observed among the pre-service teachers who prefer knowledge transmitter, Facilitator and Delegator teaching styles. Firstly, when the Expert teaching style was analyzed, significant differences were found between the 4th grade pre- service teachers and the pre-service teachers at each grade level. In all these significant differences, there is a result against the 4th grade group. When the 1st, 2nd and 3rd grade students were analyzed separately, it can be said that they had higher averages than the 4th grade student teachers.

Another teaching style with a significant difference was the Facilitator teaching style. Significant differences were found between 1st grade and 4th grade and between 3rd grade and 4th

grade groups. Accordingly, in the dimension of guiding teaching style, significant differences were found in favor of pre-service teachers in the 4th grade group in both groups. Finally, there is a group in which there is a significant difference within the Delegator's teaching style. Accordingly, there is a significant difference between the 2nd and 3rd grade groups in favor of the pre-service teachers in the 3rd grade group.

Table 6. Differentiation Levels of Preservice Teachers' Teaching Style According to Subject Variable

Teaching Style	Departments	f	Mean	DF	X^2	p	Difference
Facilitator	Primary School	50	41.78	5	15.074	.000*	1-3, 2-5
	Preschool Education	30	21.87				
	Science Education	26	19.18				
	Social Sciences Education	37	36.30				
	First. Mat. Education.	15	17.92				

According to the results of the analysis, it is seen that the only teaching style in which there is a statistically significant difference between the groups within the department variable and the teaching styles of pre-service teachers is the guiding teaching style (X^2 (5) = 15.074; $p<0.05$). It is a remarkable finding that there is no significant difference in any of the other teaching styles. In the same way, the groups between which these differences were found were determined by Mann - Whitney U test and shown in Table 7. Each department is symbolized with a number. Accordingly;

(1)Primary School
(2)Preschool Education
(4)Social Studies Education
(5)Primary Mathematics

(3)Science Education Education

Table 7. Analysis of Differences between Groups

Teaching Styles	Differences	Departments	f	Row Total	Rank Mean	U	Z	p
Facilitator	1-3	Primary School	50	923.0	47.92	379.0	-1.072	.012
		Science Education	26	976.5	38.85			
	2-5	Preschool Education	30	926.0	41.03	392.5	-1.933	.006
		Primary Mat. Education.	15	957.5	27.51			

*Significant at p<0.05

It is seen that the last independent variable determined in the study, which is the department variable, creates a significant difference in the guiding teaching style among the teaching styles of pre-service teachers. According to the results of the Mann Whitney U test applied to see which groups there are significant differences within the department variable, significant differences were found between Primary School and Science Education and between preschool education and elementary mathematics education. Accordingly, firstly, when the mean ranks between Primary School and Science Education were examined, a significant difference was found in favor of Primary School, and when the mean ranks between preschool education and elementary mathematics education were examined, a significant difference was found in favor of preschool education. It is a remarkable finding that there is a difference in favor of pre-service teachers studying in Primary School and pre-school education within the Facilitator teaching style, which shows a student-centered teaching style feature.

Findings Related to the Differentiation Levels of Prospective Teachers' Perception Levels Towards Active Learning According to Gender, Grade and Departments

The third sub-problem examined within the scope of the research was formed as "Do the perception levels of pre-service teachers towards active learning differ according to gender, grade and department variables?". The scale on which the perception levels towards active learning were determined was analyzed as one-dimensional.

Table 8. Differentiation Levels of Prospective Teachers' Perception Levels towards Active Learning According to Gender Variable

Gender	f	Mean	Ss	t	p
Female	285	74.08	3.885	2.159	.000*
Male	115	67.41	3.959		

*Significant at p<0.05

The perception levels towards active learning, which constitute the second dimension of the research, were measured on the pre-service teachers in the same sample group and it examined whether it created differentiation through the independent variables determined. Accordingly, it was aimed to determine whether the gender variable had a differentiation effect on the perception levels of pre-service teachers towards active learning with t-test analysis.

When the groups in the gender variable, which was found to be normally distributed using the Kolmogorov-Smirnov test, were examined, it was concluded that female pre-service teachers ($\bar{X}$=74.08) had a higher average than male pre-service teachers ($\bar{X}$

=67.41). Accordingly, it can be interpreted that Females have higher perception levels towards active learning than boys.

Table 9. Differentiation Levels of Prospective Teachers' Perception Levels towards Active Learning According to Grade Variable

Grades	f	Mean	DF	X^2	p	Difference
Grade 1	112	57,52	5	16.112	.011*	2-4, 2-3, 1-2,
Grade 2	119	61,84				
Grade 3	91	51,33				
Grade 4	78	45,63				

*Significant at p<0.05

According to the results of the analysis, it is seen that there is a statistically significant difference (X^2 (5) = 16.112; p<0.05) between the groups within the grade variable and the perception levels of pre- service teachers towards active learning. In the same way, the groups between which these differences are between were determined by Mann - Whitney U test and shown in Table 10. Each department is symbolized with a number as shown in the previous sub-problem.

Table 10. Analysis of Differences between Groups

Differences	Departments	f	Row Total	Rank Mean	U	Z	p
2-4	Grade 2	119	1523.0	61.02	572.0	-1.552	.022
	Grade 4	78	1476.5	48.95			
2-3	Grade 2	119	1526.0	59.13	598.5	-1.975	.016
	Grade 3	91	1457.5	47.51			
1-2	Grade 1	112	1563.0	60.67	569.0	-1.669	.009
	Grade 2	119	1596.5	58.07			

*Significant at p<0.05

The Mann Whitney U test, which was applied in pairs among the groups within the Grade variable, was used to see which group obtained meaningful results in favor of each other. Accordingly, first

[2-4], it is seen that there is a significant difference between 2nd grade (Rank Mean = 61.02) and 4th grade (Rank Mean = 48.95). According to the rank averages obtained, it is concluded that the 2nd grade group has higher perception levels towards active learning than the 4th grade group.

According to Table 10 [2-3], another significant difference was observed between 2nd grade (Rank Mean = 59.13) and 3rd grade (Rank Mean = 47.51). Accordingly, it is concluded that the 2nd grade group has higher perception levels towards active learning than the 3rd grade group. It can be interpreted that 2nd grade pre-service teachers have higher perception levels towards active learning than both 4th and 3rd grade pre-service teachers.

The group with the last significant difference [1-2] is between 1st grade (Rank Mean = 60.67) and 2nd grade (Rank Mean = 58.07). According to these data, it is concluded that the 1st grade group has higher perception levels towards active learning than the 2nd grade group. However, it is a remarkable finding that in the first two differentiations, pre-service teachers studying in the 2nd grade have a higher average than pre-service teachers studying in the 3rd and 4th grades, while in the last differentiation, pre-service teachers studying in the 1st grade have higher perception levels of active learning than pre-service teachers studying in the 2nd grade.

Table 11. Differentiation Levels of Prospective Teachers' Perception Levels towards Active Learning According to Subject Variable

Grades	f	Mean	df	X^2	p	Difference
Primary School	80	47,12	4	15.882	.004*	1-2, 1-3, 2-4
Preschool Education	80	51,89				

Science Education	80	53,83				
Social Sciences Education	80	45,04				
First. Mat. Education.	80	46.66				

*Significant at p<0.05

According to the results of the analysis, it is seen that there is a statistically significant difference (X^2 (4) = 15.882; p<0.05) between the groups within the department variable and the perception levels of pre-service teachers towards active learning. In the same way, the groups between which these differences are between were determined by Mann - Whitney U test and shown in Table 12. Each department is symbolized with a number as shown in the previous sub-problem.

Table 12. Analysis of Differences between Groups

Differences	Departments	f	Row Total	Rank Mean	U	Z	p
1-2	Primary School	80	1088.0	59.22	589.0	-1.258	.036
	Preschool Education	80	1096.5	59.04			
1-3	Primary School	80	1053.0	61.57	517.5	-1.207	.008
	Science Education	80	1041.5	58.91			
2-4	Preschool Education	80	1057.0	60.20	502.0	-1.017	.017
	Social Science Education	80	1087.5	58.93			

*Significant at p<0.05

The results of the Mann Whitney U test, which was applied to see between which groups the differentiation caused by the department variable, which was determined as the last independent

variable of the research, on the perception levels of pre-service teachers towards active learning was between, are shown in Table 3.11. According to this, firstly, it was seen that there was a significant difference between [1-2], Primary School (Rank Mean = 59.22) and preschool (Rank Mean = 59.04). However, it was concluded that the perception levels of pre-service teachers studying in Primary School towards active learning were higher than pre-service teachers studying in preschool education with an exceedingly small difference.

According to Table 3.11 [1-3], another significant difference was observed between the 3rd grade science education (Rank Mean = 61.57) and the 3rd science education (Rank Mean = 58.91). Accordingly, it is concluded that the perception levels of the Primary School group towards active learning are higher than the science education group. The findings obtained can be interpreted as pre-service teachers studying in Primary School have higher perception levels towards active learning than pre-service teachers studying in both pre-school and science education.

The last group [2-4] in which there was a significant difference was between preschool (Rank Mean = 60.20) and social studies (Rank Mean = 58.93). According to these data, it is concluded that the preschool group has higher perception levels towards active learning than the social studies group. Another finding is that pre-service teachers in Primary School and pre-school education, which provide education to early age groups, have a higher average in their perception levels towards active learning compared to other departments.

Findings Regarding the Relationship Between Preservice Teachers' Teaching Styles and Their Perception Levels of Active Learning

Within the scope of the research, Pearson Moment two-way correlation analysis (r) was applied to determine whether there is a linear relationship between the predictor variables (teaching styles) and the predicted variable (perception levels of active learning).

Table 13. The Relationship Between Teaching Styles and Perception Levels Towards Active Learning

Teaching Styles	For Active Learning Perception Levels	
Expert	Pearson Correlation Sig.(2-tailed)	.227 .000
Formal Authority	Pearson Correlation Sig.(2-tailed)	.272 .014
Personal	Pearson Correlation Sig.(2-tailed)	.321 .021
Facilitator	Pearson Correlation Sig.(2-tailed)	.899 .005
Delegator	Pearson Correlation Sig.(2-tailed)	.785 .000

When the relationship between pre-service teachers with Expert teaching style and their perceptions towards active learning was examined (r=-.227, p=.000), it was observed that there was a low level and positive relationship. When the relationship between pre-service teachers with Formal Authority teaching style and their perceptions towards active learning was examined (r=-.272, p=.014), it was observed that there was a low level and positive relationship. When the relationship between pre-service teachers with personal teaching style and their level of perception towards active learning was examined (r=321, p=.021), it was observed that there was almost a low level and positive relationship. When the relationship between

pre-service teachers with Delegator teaching style and their perceptions towards active learning was examined (r=.899, p=.005), it was observed that there was an extremely high and positive relationship. Finally, when the relationship between pre-service teachers with Delegator teaching style and their perception levels towards active learning was examined (r= .785, p=.000), it was observed that there was an elevated level and positive relationship. The fact that there is an exceptionally low correlation between Expert and Formal Authority teaching styles and perception levels towards active learning reveals that there is not an extraordinarily strong relationship between them. The significant correlations in all sub-dimensions make the correlation coefficients significant.

Findings Related to the Effect of Preservice Teachers' Teaching Styles on their Perception Levels of Active Learning

As can be seen in Table 13, the relationships between teaching styles and perceptions towards active learning are positive. Before conducting the multiple regression analysis, the assumptions required for this analysis were tested to ensure the appropriateness of the model. First, scatter plots and partial regression plots were examined to assess linearity, and the relationships between independent variables and the dependent variable were found to be linear. Multicollinearity was assessed through the Variance Inflation Factor (VIF) and Tolerance values. All VIF values were below 5, and tolerance values were above 0.2, indicating no multicollinearity issues. The normality of residuals was evaluated using histogram and normal probability (P–P) plots of the standardized residuals, both of which showed an approximately normal distribution. Homoscedasticity was checked through scatterplots of residuals against predicted values, and no funnel-shaped pattern was observed, indicating constant variance. Independence of errors was tested with the Durbin–Watson statistic, and the result (DW = 1.94) was within

the acceptable range of 1.5–2.5. Finally, outliers and influential cases were examined using standardized residuals, Cook's distance, and leverage values. No data point exceeded the threshold for undue influence. These diagnostic tests confirmed that the assumptions of multiple regression analysis were adequately met, and the analysis was carried out accordingly.

The results of the stepwise multiple regression analysis conducted to find out which of the teaching styles have more effect on the level of perceptions towards active learning are shown in Table 14. R^2 in the table indicates the percentage of variance in the dependent variable caused by the independent variable in the regression equation; ΔR^2 indicates the contribution of the new independent variable added to the equation to the explained variance; ΔF indicates the F value when the variable is added; and Δp indicates the significance level of the contribution of the new variable to the explained variance. In stepwise multiple regression analysis, ß is the standardized regression coefficient that indicates the strength and direction of the relationship between the dependent and independent variables. The independent variable with the highest ß value is relatively the most crucial factor (Büyüköztürk, 2010).

Table 14. The Effect of Preservice Teachers' Teaching Styles on Their Perception Levels Towards Active Learning

Teaching Styles	MODEL SUMMARY				COEFFICENT			ANOVA	
	R^2	ΔR^2	ΔF	Δp	ß	t	p	F	p
Expert	.193	.193	28.775	.000	.287	2.335	.000	28.775	.000
Formal Authority	.285	.118	21.557	.004	.277	3.004	.004	26.966	.000
Personal	.367	.074	9.785	.006	.234	2.552	.000	21.417	.000
Facilitator	.399	.082	8.471	.000	.301	3.521	.003	18.632	.000
Delegator	.453	.068	7.885	.003	.299	2.885	.006	15.687	.000

Note: Standard ß weights and t values are based on the last step (step 5).

In the stepwise multiple regression analysis, it was found that knowledge transmitter style (ΔF=28.775, Δp=0.000) was the first teaching style to enter the equation, Formal Authority teaching style (ΔF=21.557, Δp=0.004) was the second, personal teaching style (ΔF=9.7850, Δp=0.006), fourthly added mentor teaching style (ΔF=8.471, Δp=0.000) and fifthly added Delegator teaching style (ΔF=7.885,

Δp =0.00) explained a statistically significant percentage of the variance observed in the perception levels towards active learning. In the last step where all five independent variables were added, the multiple regression model between the independent variables and the variable of perception level towards active learning was found to be significant (F=15.685, p=0.000).

The final model explains 45.3% (R^2=0.453) of the change in the level of perception of active learning. In addition, when the ß values are analyzed, it is seen that the mentor teaching style is the most important independent variable affecting the level of perception of active learning and there is a significant and positive relationship between these two variables (ß=0.301, t=3.521, p=0.003). The second teaching style that influences the level of perception of active learning is Delegator teaching style (ß=0.299, t=3.521, p=0.006). The third variable that affects the level of perception of active learning is Expert teaching style (ß=0.287, t=2.335, p=0.000). The fourth variable that has a significant effect on the level of perception towards active learning is Formal Authority teaching style (ß=0.277, t=3.004, p=0.004) and the last variable that influences the dependent variable is personal teaching style (ß=0.234, t=2.552, p=0.000).

The results revealed that the most influential style on the level of perception towards active learning was the guiding teaching

style, followed by Delegator, knowledge transmitter, Formal Authority and personal teaching styles.

Findings Regarding the Explanatory Power of Teacher Styles with Adjusted R^2 in Regression Model

Within the scope of this sub-problem, multiple regression analysis was conducted to determine the predictive power of pre-service teachers' teaching styles towards active learning and the explanatory power of the model was evaluated with the adjusted R^2 value. Adjusted R^2 was calculated to measure the performance of the model more accurately according to the number of independent variables. This statistic more accurately reflects the explanatory power of the model on the dependent variable by considering the number of independent variables and sample size. Adjusted R^2 minimizes the risk of overfitting while assessing whether each new independent variable added increases the explanatory power of the model (Montgomery & Peck, 2021).

Table 15. The Effect of Preservice Teachers' Teaching Styles on their Perception Levels towards Active Learning (with Adjusted R^2 Value)

Teaching Styles	R	R^2	Adjusted R^2	F	p
Expert	0.453	0.205	0.201	28.775	0.000
Formal Authority	0.399	0.159	0.154	21.557	0.004
Personal	0.367	0.134	0.128	9.785	0.006
Facilitator	0.321	0.102	0.097	8.471	0.000
Delegator	0.285	0.089	0.084	7.885	0.003

When Table 15 is examined, it is seen that the adjusted R^2 values in the regression model are generally lower than the R^2 values. This shows that increasing the number of independent variables does

not contribute to the explanatory power of the model or some variables of the model may be unnecessary. The variable with the highest predictive power among the teaching styles is the Expert teaching style, and the contribution of this variable to the explanatory power of the model is higher than the other variables (Adjusted R^2 = 0.201). However, the low adjusted R^2 values for Formal Authority and Delegator teaching styles suggest that these variables may not be a strong explanatory factor in the model.

4. Discussion, Conclusion and Recommendations

In this study, it was examined whether the teaching styles and perception levels towards active learning of 400 pre-service teachers studying in five departments of the faculty of education are differentiated by the determined variables, in which direction there is a linear relationship between them and how much effect the pre-service teachers' teaching styles have on their perception levels towards active learning.

Firstly, frequency distributions of pre-service teachers' teaching styles according to gender, grade and department variables were analyzed. It was concluded that only male pre-service teachers outperformed female pre-service teachers in the Expert teaching style, while the frequencies of female pre-service teachers were higher in all other teaching styles. In the study conducted by Altay (2009), it was seen that female teachers showed a higher frequency distribution than male teachers in student-centered and teacher-centered teaching styles groups. When the frequency values of the pre-service teachers in the Grade variable, which is another independent variable, are examined, it is observed that there is a decrease in the teacher-centered teaching styles of knowledge transmitter and Formal Authority teaching styles, while there is a noticeable increase in the guiding teaching style (Grasha, 2004),

which is a student-centered teaching style that incorporates the characteristics of the constructivist learning approach, which can be interpreted as changes in the perspective of pre- service teachers on the learning-teaching process. Here, repeated study with the same sample group for four years can be considered as an important study that can support the verification of this hypothesis. Finally, when the independent variable departments were examined, it was found that pre-service teachers studying in Primary School and preschool education were clustered in Facilitator and Delegator teaching styles, while pre-service teachers studying in science and mathematics education were clustered in teacher-centered teaching styles. In the study conducted by Saracaloğlu, Dedebali, Dinçer, and Dursun (2010), the highest frequency of knowledge transmitter and Facilitator teaching styles was seen in Primary School teachers, the highest frequency of Formal Authority and Delegator teaching styles was seen in science teachers, and the highest frequency of personal teaching style was seen in Turkish teachers. It is noteworthy that student-centered teaching styles are the dominant teaching styles felt by pre-service teachers who spend more time with their students during school hours. On the other hand, the fact that the teaching styles felt more effective by the departments in which academic and theoretical knowledge is more intense and in which courses with numerical content are included are Expert and Formal Authority teaching styles can be interpreted as that these pre-service teachers should transfer more knowledge to the students while creating the learning-teaching process and that they are the sole dominators of the Primary School.

After the frequency distributions, in the tests conducted to examine whether these independent variables created a difference on teaching styles, it was once again seen that male pre-service teachers were more teacher-centered and female pre-service teachers were more student-centered, and the data obtained supported each other.

In the study conducted by Çolak and Şensoy (2010), it was concluded that gender variable created a difference on Formal Authority and guiding teaching styles. In the test applied to the Grade variable, while there were significant differences in the groups within the Expert, Facilitator and Delegator teaching styles, it is noteworthy that there was a significant difference only in the Facilitator teaching style within the department variable, and that the pre-service teachers who preferred personal and Formal Authority teaching styles did not differentiate by any independent variable. The judgment of many authors referenced in the literature, especially Grasha, that the teaching styles of teachers can change according to the structure of the course (Grasha, 2002; 2003; Wheelis, 2004; Üredi, 2006; Ray, 2003) has once again emerged with this result.

When the perception levels of the pre-service teachers analyzed within the scope of the research are examined, it is seen that Females show a higher level of perception than boys. When this situation is analyzed through the items in the perception level scale for active learning, it can be interpreted that female pre-service teachers are more prone to active learning than male pre-service teachers. In terms of grade level, the findings revealed that first-year pre-service teachers had the highest average scores regarding active learning perception, followed by second-year students. This result may be related to the fact that first-year students are more exposed to general educational courses that emphasize contemporary instructional strategies, including active learning, during the early stages of their training. In contrast, second-year students, who are in the intermediate phase of their education, may be more focused on theoretical content rather than hands-on instructional practice, which might slightly lower their perception levels. Nevertheless, the relatively high scores of second-year students compared to upper grades could be further explored through a qualitative study to better

understand the transitional dynamics in their pedagogical development.

Additionally, female pre-service teachers were found to have significantly higher active learning perception scores than their male counterparts. This may be attributed to gender-based differences in attitudes toward collaborative and student-centered learning. Previous research suggests that female pre-service teachers are often more receptive to affective and interpersonal aspects of learning environments, which are integral to active learning strategies. This difference highlights the importance of considering gender-sensitive pedagogical approaches in teacher education programs.

Finally, in terms of the department variable, it is seen that pre-service teachers studying in Primary School and preschool education have higher averages as in teaching styles. This result shows that in our education system where constructivist learning theory is adopted, teaching styles and active learning support each other in terms of departments where student-centered approach is used more effectively.

The finding that student-centered teaching styles (such as Facilitator and Delegator) are strong predictors of active learning perception is in line with the results reported by Üredi & Üredi (2007) and Altay (2018), who emphasized that student-focused instructional behaviors promote higher levels of engagement and learning autonomy. These styles allow for more flexible, collaborative environments where students are encouraged to participate actively, which directly supports the core principles of active learning. Conversely, the weaker correlation found in teacher-centered styles, such as Formal Authority and Expert, aligns with findings from Felder & Brent (2005), who observed that didactic approaches often limit student initiative. However, unlike the study

by Sarı (2020), which found no significant difference in active learning perceptions across teaching styles, this study suggests a meaningful differentiation. This discrepancy may stem from the diversity of the sample or the context of teacher training in different institutions.

Another interesting finding is that female pre-service teachers scored higher in active learning perception than males. This result echoes the work of Saban (2009), who noted that female teacher candidates often exhibit higher interpersonal sensitivity and are more open to collaborative learning environments. Nevertheless, this gender-based variation calls for further investigation, as cultural, social, and pedagogical factors may all play a role. Additionally, the observation that first-year pre-service teachers had the highest perception scores contradicts the general assumption that pedagogical competence improves with experience. Similar results were found in a study by Kaya and Demir (2021), which showed that early-year students may be more idealistic and receptive to contemporary methods, while senior students tend to become more pragmatic. This may suggest that initial teacher training should place greater emphasis on sustaining constructivist perspectives throughout the program.

In one of the sub-problems supporting the correlational findings, the relationship between pre-service teachers' teaching styles and their perception of active learning was examined. Although all sub-dimensions were positively correlated, the relationship was found to be weak in teacher-centered styles such as Knowledge Transmitter and Formal Authority, and stronger in student-centered styles such as Facilitator and Personal Model. These findings are in line with previous studies emphasizing that teaching styles based on learner autonomy and guidance significantly contribute to the effective implementation of active

learning strategies. For instance, Grasha (1996) argued that instructors adopting facilitating and delegating roles tend to create environments more conducive to active engagement. Similarly, Üredi and Üredi (2007) reported that pre-service teachers who preferred more student-centered styles demonstrated higher motivation and openness toward interactive learning processes. These correlations suggest that pre-service teachers who adopt student-centered teaching styles are more likely to value and apply active learning techniques in their future classrooms. To validate this interpretation and establish causality, further experimental research could be conducted on how teaching style orientation influences the use of active learning strategies in practice.

When regression analyses were examined, the predictive power was analyzed to see to what extent pre-service teachers' teaching styles affect their perception levels towards active learning. According to the findings obtained, the fact that it can explain an extremely high percentage can be interpreted as summarizing the effective power of the effect and relationship between them within the scope of the whole study. Likewise, the fact that mentor teaching style is the independent variable that affects the level of active learning perception the most summarizes this whole study. In addition, examining the adjusted R^2 values provided the opportunity to evaluate the explanatory power of the regression model used in predicting the perception levels of pre-service teachers' teaching styles towards active learning more precisely. As shown in Table 15, the Expert teaching style provides the highest explanatory power compared to the other styles. However, it was observed that Formal Authority and Delegator teaching styles did not have significant explanatory power in the model. These results suggest that the effect of teaching styles on active learning processes may differ and teacher education programs should be developed by taking these differences into consideration.

Increasing the independent variables in the regression model does not always make the model better. On the contrary, lower adjusted R^2 compared to R^2 indicates that some independent variables may be unnecessary for the model (Montgomery & Peck, 2021). In this context, it is recommended to develop optimized models with more variables to understand the impact of teaching styles on active learning. The results of the research reveal that teacher training programs should be developed to increase awareness of teaching styles. For pre-service teachers to make active learning processes more effective, teaching styles should be emphasized in pedagogical formation courses and this awareness should be supported with practical training. In future studies, it is recommended to conduct studies examining the interaction of teaching styles with different teaching methods. In addition, longitudinal studies are needed to evaluate the long-term effects of pre-service teachers' teaching styles. In conclusion, this study aims to contribute to the practices in the field of education by evaluating the effect of preservice teachers' teaching styles on their perceptions of active learning in an academic framework.

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CHAPTER 3

INNOVATION: REDEFINING LIBRARIES IN THE AGE OF DIGITAL TRANSFORMATION

Güler DEMİR[1]

Introduction

The concept of innovation, which refers to the transformative capacity to create something new or improve existing structures (Innovation, 2025a), is closely related to technology. Technology is both a trigger and a product of innovation. On the other hand, digitalization is a concept that arises from innovation. However, innovation is not limited to these concepts; it is a multidimensional phenomenon with a broad scope encompassing economic, managerial, systemic, technological, digital, social, cultural, and psychological aspects. This relationship between innovation and technology is rapidly gaining recognition on the world agenda as the key to development.

Broadly defined, innovation encompasses new ideas, designs, products, and methods that bring about change and improvement. Innovation is emphasized for stimulating economic growth, increasing demand, and promoting investment and employment opportunities (Innovation, 2025b). The definitions in the leading dictionaries converge on several key themes common to this

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concept: originality, the technological context of new developments, and the economic impact of introducing new solutions.

Libraries and information centers are not just facing changing user needs and rapidly digitalizing environments, but also a shift in focus. The days of surviving as traditional information repositories are over. To thrive in the modern competitive age, libraries must not only meet user demands with maximum efficiency and diversify their services, but also prioritize user participation and experiences. In this context, innovation is an important solution, as it can transform libraries into dynamic information management and innovation centers, where user participation and experiences are at the forefront of operations.

This chapter highlights the importance of innovation in libraries and the opportunities it offers. The study examines various dimensions of innovation, including product, service, process, marketing, and organizational innovations defined by Güçkıran (2021) and exemplified by Demir (2024). For libraries to gain competitive advantage and develop and effectively meet the various needs of their societies, it is important to evaluate innovation in all its dimensions from a holistic perspective.Innovative tools and environments provide libraries with numerous benefits. These systems make routine library tasks easier to perform, allowing librarians to spend their time on more creative and practical tasks and to focus more on self-development. So, librarians can be more innovative and entrepreneurial and freely reveal their potential. These technologies encourage community participation, diversify users' experiences, and increase satisfaction. Innovative technologies and innovations, including service and process innovations, simplify and accelerate library operations and create new forms and environments for learning and collaboration.

This chapter also points out the situations that negatively affect libraries' adoption and adaptation of innovative technologies. The

lack of knowledge, skills, awareness, and training of staff regarding these technologies, technological accessibility problems, and cultural resistance problems are at the forefront. Empirical studies show that many libraries recognize the importance of innovation. However, financial constraints and the problems mentioned above often hinder their ability to exploit new opportunities fully.

By comprehensively analyzing literature and case studies, the study provides a perspective on how libraries can effectively utilize innovative practices.

Innovation Concept

Cambridge Dictionary defines innovation (Innovation, 2025a) as “a new idea, design, product, etc.” and explains it as “innovations in sth recent innovations in technology”. The Dictionary also points out that “Product innovations lead to an increase in effective demand which encourages an increase in investment and employment.” Merriam-Webster Dictionary (Innovation, 2025b) describes this concept as “a new idea, method, or device : novelty,” and “the introduction of something new.” Oxford Learner’s Dictionaries (Innovation, 2025c) defines it as “The introduction of new things, ideas or ways of doing something an age of technological innovation”.

Based on these definitions, it is possible to make the following inferences about the standard features of the concept of innovation: All definitions refer to a new idea, design, or product. The main feature of innovation emphasized by the dictionaries here is originality, which can be a new idea, design, or product. The definitions particularly emphasize the technological context of innovation, which shows that technological innovations are an important component of innovation. In addition, innovation is also

related to economic growth and development. New products and/or improvements in products can increase demand and lead to an increase in investment and employment. Apart from this, based on the standard inference of the dictionaries, innovation can be defined not only as a product but also as new methods or devices. In this case, the concept spreads over a wide range, and these shared features constitute the general framework of the innovation concept. The word "innovation" comes from the words "innovare" and the Latin noun "innovatus". The word means to transform an idea or process into a demanded product or value-added service and to create or do something new. Defining innovation as novelty is one of the oldest trends in innovation research (Baranskaitė & Labanauskaitė, 2020, p. 51). In modern literature, there are two approaches to innovation. The first one considers innovation as the result of any process. The second one considers it as the process of implementing an innovation. According to the first approach, innovation is a result. Innovation is not innovation; it becomes innovation from the moment it is accepted for implementation. Innovation is a definite result of scientific R&D, such as patents, licenses, know-how, discovery, invention, and trademark. In terms of time, the period between the end of an innovation and the beginning of an innovation is called "commercialization." In contrast, the period between the beginning of an innovation and the beginning of an innovation is called innovation lag. Innovation results in a change in the factors of production and the object of management and, at the same time, reflects the result of the implementation of the innovation. When considering the "source of innovation," modern literature identifies two approaches. The first one emphasizes that innovation is the result of an R&D activity and the implementation of the innovation. The second one considers the interactions and informal relations that facilitate knowledge exchange (Melnikova, 2017, p. 172). It is possible to classify innovation according to different perspectives, including but not

limited to their subject, degree of innovation created by their results, strategy, form of emergence in the organization, source, social effects, and cooperation model (Güçkıran, 2021). Below are some general types of innovations that companies can use to gain competitive advantage (Demir, 2024):

- Product innovation: Designing and launching new or improved products. For example, a new smartphone model.
- Service Innovation: Improving existing services or introducing entirely new services. For example, online education platforms.
- Process innovation: Developing different methods or improving existing methods in producing or distributing a product.
- Marketing Innovation: Developing new marketing strategies or methods. For example, social media campaigns.
- Organizational Innovation: Innovative changes to internal company structures and management systems. For example, flexible working hours.

As mentioned above, innovation is the novelty provided in products, services, or processes using existing information in new and creative ways. In this context, libraries actively participate in innovation processes and produce innovative solutions to improve information access, user experience, and service delivery. Innovative libraries based on the advantage of digital transformation offer new services, facilitate and accelerate access to information, and increase social awareness. Thus, there is a dynamic interaction and relationship between innovation and libraries that strengthens the role of libraries in the information age.

Innovation in the Context of Libraries: Why should libraries innovate?

Libraries play a central role in information management and innovation because they help individuals and organizations develop their dynamic capabilities by supporting the processes of accessing, sharing, and transforming information. Therefore, libraries are important actors supporting information creation and innovation processes beyond being mere repositories of information. As Korkmaz (2023, p. 62) mentioned, innovation is creating new combinations of existing elements, including acquiring, disseminating, and using information. Effective information management allows individuals and groups to create, preserve, and share information. Innovation occurs through the interactive exchange of information among participants, and information sharing enriches the organization's information stock by encouraging collective learning. Successful innovations require new information combinations by developing new relationships among existing individuals. As a result, information management enables the development of new products and the emergence of innovative ideas by integrating existing and new information.

There are some fundamental reasons why libraries need to innovate. Libraries must constantly adapt to changes, such as the transformation from print-based to digital. Moreover, users' traditional information-seeking behaviors via OPAC and local discovery systems have become obsolete. In addition, libraries need to improve their current products and services continuously. Examples include making more use of the power of RFID or making improvements to workspaces. Apart from this, libraries need to take advantage of new opportunities. Furthermore, library lending and the physical use of printed resources are decreasing. Innovation is one of the most effective solutions to face such challenges (Ramjaun, 2022).

Another reason that requires libraries to innovate is the perception that there is no need for libraries due to alternative environments that

develop access to information and information sources in the digital age. Innovation is an ideal response to destroy this perception. Once internet cafes increased rapidly, many thought that library membership would decrease sharply. However, it was the opposite because the forward-looking librarians built cyber corners in the library buildings. In these areas, they pioneered innovation by providing their users with free or cheap internet access. Libraries that offer information sources and services in their virtual environment increase. Since 2010, approximately 800 British Public Libraries have been known to be closed due to the failure of adopting innovations (Ramjaun, 2022). Search engines can help to find everything, but libraries play a critical role in finding reliable sources, providing guidance for access to information, and meeting the information needs of society. It also brings together physical fields and communities and protects cultural heritage. Innovation is a critical key to the survival and gradual development of libraries. In short, many new technologies, activities, and applications are important for libraries to solve the problems created by the traditional structure and transform it into an innovative structure. These can be summarized as follows:

New Technological Trends and Applications in Libraries

So many new technological trends and developments affecting libraries today include information technology, automation, artificial intelligence, and data analytics. These technologies eliminate the burden of traditional practices and manual processes. They improve library operations and user experiences, leading to efficiency and new growth opportunities. Technological developments transforming libraries, such as cloud computing, e-books, RFID, digital preservation, and mobile applications, are rapidly advancing (Okwu, Okwu, & Oladokun, 2024, p. 2). One of the other example of innovation that will solve this problem is maker spaces (Soomro

et al, 2023, p. 530). A brief explanation of these systems and their functions is below:

Cloud computing: Cloud computing uses a network of remote servers placed on the Internet to store information on a website in a remote location, among the valuable systems for libraries. This system allows the library to easily store website content in the cloud, making it accessible without time or space limitations (Okwu, Okwu, & Oladokun, 2024, p. 2).

RFID (Radio Frequency Identification): RFID is "A data collection technology that uses electronic tags for storing data. The tag, also known as an "electronic label," "transponder" or "code plate," is made up of an RFID chip attached to an antenna. Transmitting in the kilohertz, megahertz and gigahertz ranges, tags may be battery-powered or derive their power from the RF waves coming from the reader." (Ziff Davis, 2025). RFID tags are essential for innovative libraries in many contexts. They automate many processes such as the borrowing and returnprocessesss and simplify operations. These systems make it easier for users to complete their transactions. These tags enable users to self-service and multitask up to nine books simultaneously, conserving resources and improving service quality. RFID systems provide solutions to library self-service machines, book search, security, tag upgrades, and related challenges. So, by using RFID systems, libraries reduce human resource needs (Zhang & Chen, 2019, pp. 306-307)

Digital preservation: Digital collections are important for libraries because the loss of these library resources would have irreparable and detrimental effects on the intellectual perception of future generations. In order to preserve digital materials, libraries need to implement specific strategies. Libraries can use various tools, devices, and settings to preserve these materials. In this context, it is possible to use various software and hardware products of today's technologies to take precautions, store data securely, and access it

easily. In particular, places such as national libraries should adopt such preservation methods to ensure that digital data is constantly accessible (Samiei, 2020, pp. 127-128). According to Hedstrom (1998), proven strategic methods are crucial for successful digital preservation. In this context, innovative approaches are essential. The obsolescence of storage media and software is among the significant challenges. In this case, preservation methods lag behind technological developments. This makes access to digital information difficult. Libraries should implement better migration techniques and innovations to transfer digital content to new formats. In addition, more research is needed for scalable and cost-effective digital preservation solutions. Like Hedstrom (1998), Ross (2012) emphasizes the need for innovation because of the lack of technology maturity in the context of digital preservation issues. It is necessary to develop appropriate automated systems to manage digital preservation processes successfully and effectively and to secure digital objects. Ross (2012) suggests a research agenda focusing on restoration, preservation, collection management, and usability in this context. Digital librarians can also collaborate with archivists and IT professionals. Libraries can ensure the longevity of digital materials through innovations in storage technologies and strategies.

Mobile applications: Today, most internet users access the internet from mobile devices and computers. Aware of this situation, institutions aim to reach their audience through digital channels. They are renewing their systems to participate in the mobile world and respond to changing user trends (Işık, 2019, p. 70). Due to this trend, libraries have also rapidly adopted mobile applications and adapted them to their services. These developments make it easier for libraries to provide information services to their users from mobile devices. The development of mobile applications for libraries is reminiscent of the development of library automation in the late

1980s and early 1990s. Initially, OPAC was used as isolated computer applications. Today, mobile applications are developed for platforms such as Android and Windows, and various tools and technologies are used. Android applications are generally developed using JavaScript, while Apple applications are developed using X-code for devices such as iPhones and iPads. Mobile tools commonly used in the development of library services are applications such as Mobile OPAC, mobile websites, databases, WhatsApp, SMS and QR codes (Singh & Madhusudhan, 2023, pp. 83-84). Libraries can use mobile applications to facilitate users' book search and reservation processes, access digital resources and read e-books, announce library events, provide orientation, and many other functions. A gamified library orientation mobile application for Hacettepe University Beytepe Library is an example of a library application. The application has a task-based structure and uses game components such as points, rewards, levels, and badges. The library has continuously improved the design based on feedback from user tests. The library aims to make library orientations more interactive and engaging through gamification (Arkün Kocadere, 2019). Although financial constraints, limited institutional support, and staff technical skills are challenging issues for many libraries to implement these technologies, mobile applications are vital to modern libraries, providing efficient and accessible services. Libraries must continue to innovate to effectively meet users' information needs and transform libraries into attractive places (Singh & Madhusudhan, 2023, p. 90).

Makerspaces: One of the innovative solutions to the problem of reduced use of libraries due to the limited physical use of libraries due to digitalization and remote access opportunities is to encourage community participation. One of the most important environments to provide this is maker spaces. Generally, “a MakerSpace is considered a place where informal, collaborative learning and

discovery take place through hands on creation, via use of any combination of art and technology. MakerSpaces facilitate both analog (low-tech) and digital (high tech) creation" (Velasquez, n.d.). A makerspace is a place for students to implement their ideas, individually or in teams. It is "a creative and uniquely adaptable learning environment with tools and materials, which can be physical and/or virtual, where students have an opportunity to explore, design, play, tinker, collaborate, inquire, experiment, solve problems and invent." The tools used in maker spaces are digital fabrication or digital manufacturing technology. They enable computer-supported additive and subtractive manufacturing, rapid prototyping, and easy production of highly customized products. Digital fabrication technology is considered indispensable in maker spaces, such as fabrication laboratories (Fab Labs), personal fabrication settings, invention studios, design labs, and hackerspaces. Makerspaces are utilized for interdisciplinary applications and research, helping users coordinate between disciplines to develop complex engineering designs (Soomro et al, 2023, p. 530).

A study by Barrett et al. (2018) gives information about a Library/Student Innovation Center (CSIC/SIC) maker space at the University of Wyoming, USA, to address the declining use of print materials in libraries. This makerspace enhances student innovation, creativity, and entrepreneurial skills by providing hands-on learning opportunities and collaboration across disciplines. Students participate in collaborative projects that meet their creative and educational needs there. This space integrates technology and experiential education and ultimately revitalizes the role of libraries. Key findings from a study (Lee, 2021) examining technological innovation in libraries show that the leading holders of library technology patents are companies from the US, Germany, France, Japan, and the UK. The paper also examines the balance between

technology-push (advances creating new solutions) and demand-pull (user needs driving innovation). Both forces influence library advancements. The study recommends that libraries consider complex technological environments and develop institutional learning to cope with user demands. Integrating user insights and collaboration into library strategies for sustainable development in libraries is important. According to the research, libraries should encourage innovation through continuous learning and adaptation. In addition, librarians must develop technological and interpersonal skills to succeed in this evolving environment. The author recommends that libraries examine the relationship between organizational learning and different types of innovation and further diversify the metrics used to assess library technological advances.

Makerspaces provide a basis for innovation as they are centers for acquiring information, learning by doing, implementing technologies, establishing interdisciplinary collaborations, and socializing within libraries. Allocating space for maker spaces in libraries encourages the physical use of libraries by improving user discovery and interaction. Since this means improving library services and processes, service and process innovations are noteworthy in their dimensions.

Related Literature

Almost all of the sources in the literature (Adelakun & Rainwater, 2023; Alaca, 2017; Atre & Richhariya, 2023; Barrett et al., 2018; Desmarchelier, Djellal, & Gallouj, 2025; Harsanto, 2021; Hedstrom, 1998; Jharotia, 2018; Kaur & Sharda, 2020; Pellack, 2022; Ramjaun, 2022; Ross, 2012; Soomro et al, 2023; Yıldırım, 2024) emphasize the importance of innovation in libraries as it offers a wide range of opportunities. However, the authors also note the need for libraries to tackle various challenges in adapting to innovative technologies and culture. Alaca (2017) emphasizes library staff's low awareness

and different perspectives on innovation and highlights the need for in-service training and management support. Yıldırım (2024) criticizes the perception of innovation as limited to technological developments and states that foreign libraries tend to innovate more than Turkish libraries. Pellack (2022) points to the importance of fostering a culture of innovation in libraries and suggests user-centered solutions, including maker spaces and various technologies. According to Jharotia (2018), librarians must embrace technology and social media for improved user services and engagement. Kaur and Sharda (2020) argue that technological innovation is essential to meet user needs and improve library services. She also points out that a lack of IT knowledge is a significant barrier. Atre and Richhariya (2023) suggest that libraries use technologies such as cloud computing and artificial intelligence to improve their operations and provide better service to users.

Desmarchelier, Djellal, and Gallouj (2025), and Harsanto (2021) focus on facilitating innovative practices. Desmarchelier, Djellal, and Gallouj (2025) emphasize the importance of adapting to the changing needs of users and call for a greater focus on library innovations within service innovation trends. Harsanto (2021) discusses the challenges libraries face in moving from traditional structures to a more innovative state and emphasizes the need for qualitative changes in innovation management.

Barrett et al. (2018). Jharotia (2018), Pellack (2022), and Soomro et al. (2023) point to the importance of innovation in the context of community engagement and socialization. Barrett et al. (2018) discuss innovation focused on students and a specific maker space initiative to improve library use within this framework. Pellack (2022) discusses the importance of fostering a culture of innovation in libraries and states explicitly that maker spaces are an important user-centered solution. Soomro et al. (2023) describe maker spaces as centers that foster creativity, collaboration, and interdisciplinary

practices as an innovative practice. Jharotia (2018) suggests using advanced technologies and social media for improved user services and engagement.

Adelakun and Rainwater (2023) and Ramjaun (2022) conclude that traditional library systems are inadequate to meet changing user needs. Adelakun and Rainwater (2023) emphasize the importance of innovation for libraries to effectively bridge the digital divide and provide relevant services. Adelakun and Rainwater's (2023) and Harsanto's (2021) research use the pandemic as an example of a situation proving that this traditional structure has become blocked. The needs created by the pandemic have led to a new vision for libraries. This vision is important as it lays the foundation for innovative ideas. Ramjaun (2022) proposes innovation as a solution to the problem of declining traditional use of libraries due to this inadequacy and the need to adapt to digitalization.

Hedstrom (1998) and Ross (2012) emphasize the need for innovation in digital preservation practices to ensure long-term access to digital materials in libraries.

The paper elaborates on the literature mentioned above to underline the importance of the topic. The detailed reviews are as follows:

A study by Alaca (2017, pp. 211, 220-221) examines the perspectives of public library staff in Ankara on innovation and their perception and awareness levels of developing innovative services. The study used a survey of 54 staff members working in various libraries. The findings show that the participants have a low perception and awareness of innovation, have different perspectives, and need in-service training. The results reveal that social media, where young people and children are the primary target groups, are tools to follow innovative developments and that the management approach negatively affects innovation. In addition, there are misconceptions about innovation that need to be corrected. Libraries should increase

in-service training, and library management should support innovation. As a result, for public libraries to be more effective in developing innovative services, awareness should be increased through written policies and staff information. Innovation is critically important for the sustainability of public libraries, and more literature on this area is needed.

According to Jharotia (2018), librarians should embrace technology to enhance and improve user services and promote equal access to information. The author suggests various examples of these technologies. The rise of social media tools such as Facebook, Twitter, etc., presents both opportunities and challenges for libraries. Libraries can use these platforms to increase library visibility and engage more users with the library. These tools are also helpful to conduct marketing activities and collaborate with users. Mobile technology is also vital to reach users and improve services. Mobile apps perform many functions, such as catalog searches, SMS alerts, reference services, and quick access to digital content. Similarly, libraries can use smartphones and QR codes to access services quickly. Libraries should carefully implement these technologies to serve their users efficiently.

The paper by Swamy and Kishore (2019) discusses innovative practices that library professionals can implement to attract users to the library and support their academic and research goals in a digital environment. The study's findings point to several innovative services for modern libraries. These include e-mail alerts to keep users constantly informed about new arrivals and events, library web pages to provide access to resources and serve as marketing tools, remote access facilities enable users to connect to resources from anywhere and at any time, social media to disseminate information and keep users connected, mobile applications for easier access to electronic resources, QR codes for quick access to library services, live chat tools to provide real-time assistance, virtual reality to

provide immersive information experiences, 3D printing services to encourage creativity and hands-on learning, and technological accessibility facilities for visually impaired users. The research suggests that library professionals should continuously update their skills and increase their user-centered services due to the development of digital-based library services. Implementing these services is essential to improve service quality and maximize resource utilization.

Kaur and Sharda (2020) state that technological innovations, especially Information Technology (IT) and Information Communication Technology (ICT), have radically changed library services and users' information-seeking behavior. The demand for electronic resources is increasing as users prefer to search for articles online rather than physical resources. Studies show that physical library visits decrease, and users access the Internet for information. Most users prefer database searches and demand free full-text access, but they face obstacles such as time constraints, excessive information volume, and navigation difficulties. Lack of IT knowledge is a barrier to effective information search. The increasing dependence on electronic resources has transformed the role of librarians in guiding information evaluation and access processes even more important. In addition, establishing library consortia is critical to ensure resource sharing and meeting different user needs. Continuous training for library staff and users is essential for developing library services. Librarians should help users navigate e-resources and improve access to information. As a result, technological advances require librarians to adapt to new user preferences to provide adequate services.

Harsanto's (2021) study highlights innovation management in libraries. It also points to these institutions' challenges in adapting from traditional bureaucratic environments to more innovative structures. The study identified publication trends on library

innovation using bibliometric analysis and created five main categories: innovation culture, technological innovation, innovative human resources, knowledge management, and e-learning. The study indicates that libraries must adapt to rapid technological changes and evolving user behaviors. The COVID-19 pandemic has made the importance of an innovative culture even more evident. The author recommends addressing the qualitative dimensions of library innovation and understudied areas in future research. The study aims to create an innovative library environment by integrating technology, human resources, and knowledge management.

The article by Pellack (2022) provides an overview of innovation in academic libraries for librarians seeking basic information and practical ideas while clarifying complex innovation terminology. The author emphasizes that librarians need accessible explanations to understand innovation concepts. To encourage innovation, the author recommends developing a culture of risk-taking and learning from failure, designing user-centered solutions, and creating a supportive environment for creativity. The research cites the establishment of maker spaces, the use of technologies such as artificial intelligence and chatbots, and the personalization of library spaces according to different user needs as examples of innovation. In this context, the research also addresses challenges and inhibitory factors such as fear of failure and resistance to change. Pellack suggests that librarians adopt a culture of innovation and develop strategies that effectively improve library services.

Adelakun and Rainwater (2023) state that the needs that emerged from the pandemic outbreak in recent years have presented a new vision for libraries. In order to respond to the diverse and changing needs triggered by this period, libraries need to develop innovative designs to provide better services to communities and close the digital divide. In this context, the evolution of institutions into new forms, such as flexible work and entertainment spaces, emphasizes

the importance of innovation in responding to the demands of society.

Atre and Richhariya (2023) emphasize that libraries transform into virtual spaces using technological and digital tools for more practical information and resource management. In this context, cloud computing, among the technologies they use, provides easy access to resources, reduces costs, and makes efficient connections between institutions. Big data, which is the result of the conditions of this age, is another issue for libraries. Libraries improve decision-making processes regarding services and facilities by using online resources and social media to collect and analyze data. Artificial intelligence improves the development of innovative libraries, service delivery, and user experience. Internet of Things technology collects and transfers data with its functions that facilitate many processes. Blockchain technology is also an important agenda item and application for libraries. This technology provides a decentralized system for managing data and tracking digital transactions. It is beneficial for metadata systems and community-based programs. QR codes enable users to access library information through mobile devices much more quickly and easily. Social media and mobile applications facilitate communication and connection, allowing libraries to reach users quickly and keep them updated.

A study conducted by Yıldırım (2024) evaluates innovation's role in foundation university library services. In the study, the author examined the services of four foundation university libraries from Turkey and abroad by interview method. The findings show that the service diversity of foreign libraries is significantly greater than that of Türkiye. Library staff and users' interest in innovation is reasonable, but libraries abroad expect innovative services from librarians and allocate budgets for this purpose. However, such a situation is not the case in Türkiye. In addition, libraries abroad organize various innovation training programs, which is lacking in

Türkiye. The author also criticizes the perception of the limitation of innovation to technological innovations. Libraries are not only information centers but also institutions that should deal with users' psychological states. As a result, the study mentions that the innovative service pool of libraries has expanded, but foreign libraries are more advanced in some areas.

Desmarchelier, Djellal, & Gallouj (2025) point out that service innovation studies while emphasizing various sectors, do not give enough space to libraries. However, library innovation is of critical importance, especially in the face of the challenges posed by digital developments. According to the author, libraries have evolved from collection-focused structured into providers focused on user participation and serve as accessible spaces for information, education, and culture. The role of libraries as multi-faceted service providers highlights the importance of service innovation for libraries. Changes in user needs and technological advances necessitate diversification and, more importantly, innovation in library services. In line with broader service economy principles, it is necessary to direct a detailed understanding of user competencies, service characteristics, and library functions to evaluate library innovation.

Findings

This research, which reviews existing domestic and international literature on innovation in libraries and examines various empirical and theoretical studies, highlights several crucial aspects. The prominent aspects are the importance of innovation for libraries, the opportunities it offers, the transformative effects of technology, the difficulties and problems related to innovation practices, the increase in user-centered approaches that require innovation, and the need for continuous training for innovation management. The study shows that libraries know the importance and need for innovation to adapt

to changing user demands and technologies. Innovations in products, services, processes, marketing, and organizational structures are essential for libraries to increase user engagement and satisfaction and remain competitive in the digital age (Demir, 2024; Güçkıran, 2021).

The study emphasizes that various technologies and environments such as cloud computing, RFID, mobile applications, artificial intelligence, and maker spaces facilitate processes, increase accessibility, encourage collaboration among users, transform libraries into attractive environments, and provide the basis for more effective library operations (Okwu, Okwu, & Oladokun, 2024; Soomro et al., 2023).

On the other hand, the study's findings also show several obstacles despite the libraries' belief and optimistic view of the potential power of innovation. The most obvious of these obstacles is the lack of knowledge, skills, and awareness of the staff, financial constraints, and cultural resistance to change (Alaca, 2017; Ramjaun, 2022).

An important finding of the study is that libraries with successful innovative initiatives generally adopt a user-centered approach, emphasizing user participation and interaction. Makerspaces are a good example in this context because they provide hands-on opportunities for learning and creativity by meeting various user needs (Barrett et al., 2018; Pellack, 2022).

Another common and important finding of the study is the need for regular training and support to increase library staff's technological skills and adopt a culture of innovation within libraries (Yıldırım, 2024; Harsanto, 2021).

Discussion

The study's findings show that innovation initiatives and applications have become a necessity rather than an option due to the

age's scientific and technological development. Individuals' preferences and demands have also transformed in a world surrounded by digital platforms. Most people turn to the internet for information needs, especially search engines. In this context, libraries have become impossible to survive with traditional systems. Since traditional library systems cannot respond to changing demands and preferences, libraries must adapt their services and applications to their users and constantly review and update them. In such an environment where information pollution is increasing, libraries should act as a guide between their users and reliable and accurate information sources, and at the same time, they should develop services and programs that will provide their users with rich experiences and socialization opportunities.

To succeed, libraries should consider innovative approaches and be open to innovations. Libraries can diversify their service offerings and improve operational efficiency through innovations. At the same time, these libraries can serve as vital community centers by collaborating in information management, sharing, and collaboration networks. Innovative applications have the potential power to satisfy their users and so increase their access. For instance, the introduction of mobile applications offers ample opportunities for users to access library resources and services anywhere and anytime.

However, it is important for libraries to consider possible obstacles when determining the most appropriate technology and trends for themselves and to determine appropriate strategies to resolve these obstacles. Cultural obstacles such as lack of technological knowledge and staff skills, budget problems, space problems, infrastructural deficiencies, and resistance to change should not deter libraries; libraries should be determined to combat these problems. It is not difficult for libraries to create a collective, team-oriented library environment that makes decisions by informing their staff,

caring about their ideas and experiences, and understanding their concerns. Libraries can eliminate these concerns by ensuring their staff's trust and overcoming many problems through collaboration and sharing.

Conclusions and Recommendations

In conclusion, libraries can be the solution center for problems such as lack of information, concerns, and digital divides that occur in individuals due to the complexities created by a rapidly developing and diversifying information environment with their informative and educational positions. Libraries have always been intertwined with technology; naturally, every new development brings problems that are not easy to face. By addressing the contributions of innovation to libraries and the barriers to implementation in all necessary dimensions, libraries can develop as organizations that actively contribute to social progress.

The results of libraries developing themselves through innovation are not limited to user satisfaction and participation. When considered in the long term, the benefits they will achieve are much more. Ensuring their societies' educational, cultural, and intellectual development will also support economic growth and development. For all these reasons, libraries should constantly explore innovative applications, invest in human resources and capital, train their staff and users, and maintain user-focused approaches.

The basic recommendations developed based on the findings of this study are as follows:

- Libraries should first strive to create an organizational innovation culture that will provide the basis for innovation, which is possible with good governance, teamwork, motivating staff by taking their ideas and experiences into account and providing a sense of belonging. Environments, where new ideas are welcomed and tested, encourage the

creativity of library staff and reduce their anxiety. Not every new idea is expected to be successful when tested, but such results should not be reacted to with discouraging feedback.

- Libraries should invest in human capital and prioritize the training and development of their staff. To do this, libraries should prioritize the types of training programs required by the age, such as digital literacy, algorithmic literacy, and artificial intelligence literacy. Regular professional development helps library staff gain self-confidence and facilitates their openness to new technologies.
- Libraries should establish close relationships with their users and consider user feedback to attract users to libraries. Libraries can create maker spaces, workshops, and events to increase user interaction. Knowing users closely and understanding their needs and preferences leads to better service design and delivery.
- Artificial intelligence, cloud computing, mobile applications, virtual reality environments, and many other applications are facilitating and accelerating library operations and increasing user satisfaction. Libraries must keep up with emerging technologies suitable for themselves and their user base. Libraries should constantly monitor and evaluate new technologies.
- An important mission of libraries is user education. For users to acquire the knowledge and skills the digital age requires, librarians must be educated, knowledgeable, and competent in this context. Libraries that provide a strong education to their users set an example by developing their public identity and image.
- Most libraries may have budget constraints. Therefore, they may initially focus on small and/or incremental innovations

rather than costly, radical ones. They may seek grants to provide funding, and they may also seek sharing through consortia and various partnerships. For this purpose, they may collaborate with educational institutions, other libraries, or technology companies.

- Transforming libraries' plans and processes into written documents is crucial to performance and creating a culture of innovation. Written policies regarding innovation plans, projects, and initiatives, as well as guides that will be a roadmap for staff and users regarding the use of technology, can be given as examples. In short, systematically sharing almost everything with written documents and reports makes things easier.
- With their innovative initiatives, libraries can not only overcome current challenges but also create a foundation for sustainable innovation and growth in the future.

With their innovative initiatives, libraries can not only overcome current challenges but also create a foundation for sustainable innovation and growth in the future.

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CHAPTER 4

ETHICS IN MEASUREMENT AND EVALUATION IN EDUCATION: A MODEL PROPOSAL

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Introduction

Assessing students' achievement as well as other educational attributes is critical to student learning (Anastasi, 1976; Gullickson, 2005). Existence of ethical rules to guide this assessment process is also essential. Ethics, as a sub-discipline of philosophy, defines the norms and rules that those working in a particular field should follow (Green et al., 2007; Estaji, 2011; Kaya, 2015). The American Psychological Association (APA) regularly publishes and reviews codes of ethics. These codes describe the elements that psychologists should pay attention to while performing their scientific, educational and professional roles. The aim of the code of ethics is to help psychologists make the right decisions in ethical problems they face while practicing their profession (APA, 2017).

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It is necessary to address the issue of ethics in measurement and evaluation in education in the context of professional ethics for teachers. Teachers are the key component that guides and evaluates students' learning processes. For this reason, it is critical for teachers to have theoretical knowledge and practices about ethical practices in assessment and evaluation processes. Professional ethics is a set of standards and principles that guide people's behavior while they are practicing their profession and guide them on what is appropriate and inappropriate behavior (Şentürk, 2009). Although professional ethics is a valid concept for all professional groups, it gains more importance in professions that provide services directly to people, such as teaching, which is based on human relations (Gündüz and Coşkun, 2011; Yeşilyurt and Kılıç, 2014). The concept of ethics in terms of the profession of teaching, which is one of the professions where interaction with people is quite intense and in this sense, acting in accordance with ethical principles is of utmost importance, represents the rules that teachers should follow in their relationships with students, parents, colleagues, school administrators and other members of society (Erdem and Şimşek, 2013; Ilgaz and Bilgili, 2006; Yılmaz and Altınkurt, 2009).

Today, many professional groups set ethical principles and encourage their members to comply with these rules. It is also important for teachers, who are accuntable for the education of students, to abide by professional codes of ethics. In addition to encouraging their students to learn, teachers have the duty to teach them social values such as respect, honesty, responsibility, cooperation, loyalty and ethical values. Teachers are also expected to follow school rules and apply them equally. Teachers are also responsible for not deliberately belittling students and not disclosing confidential information about them. In this context, the aim of the research is to address the issue of ethics in measurement and evaluation in education and to put forward a model proposal.

Measurement and evaluation practices in education are powerful tools that can shape education and training. In recent years, the concept of ethics in the processes of educational assessment has been one of the main topics of debate among researchers. Certain principles and guidelines, defined as ethical standards, are followed to ensure effective planning, application and assessment of learning. The central question is whether the practices in educational measurement and evaluation can be regarded as ethical or moral. Educational assessment and ethics are concerned with the principles and practices that govern how student learning is measured and assessed. This paper aims to address current ethical issues in educational measurement and evaluation. It also focuses on professional ethics, particularly ethical principles related to assessment in education. Eventually, some recommendations and rules for the application of ethics in educational assessment are presented as a model to ensure the fair application of ethical principles.

Ethical Principles and Ethical Evaluation in Education

Assessment based on codes of ethics involves an approach that promotes integrity, respect and ethical standards in all practices with all stakeholders. These standards should be applied to all aspects of evaluation design and implementation. Although a code of conduct establishes basic expectations for teachers' professional conduct, it is not a comprehensive list of guidelines. The teaching process is governed by legal and regulatory frameworks. To meet the problems of teaching and learning, educators must develop new attitudes, abilities, and knowledge.

Each school board or private school develops its own professional code of ethics that teachers must follow. For example, a code of ethics may aim to address the mutual rights and responsibilities of teachers, educators and educational partners.

Moreover, such a code can provide flexibility in the application of common principles for teachers and define ethical behaviors and important issues necessary for the development and implementation of the code.

Professional educators promote personal responsibility to help students accept responsibility for their outcomes and choices. All educators have a duty to encourage virtues such as integrity, careful planning, accountability, colloboration, commitment, and respect for human life, even though parents are their children's principal ethics educators. While teachers have significant freedoms and privileges, these freedoms bring about responsibilities and ethical challenges (Mcgill, 2014). The professional educator considers success not only in terms of the student's realization of personal potential, but also as a citizen of society. Educators should deal fairly with each student, seek to resolve disciplinary problems in accordance with the law, avoid deliberately humiliating the student, not provide confidential information unless required by law, strive to keep safe students from situations detrimental to learning, health or safety, and present the facts without bias or self-interest.

Ethical issues arise when valid and competing professional interests are at stake (Ehrich et al., 2011). Exposing a child to conditions that are detrimental to learning or humiliating a child on purpose serves no valid interests; such actions are more self-interested. In licensed professions, professional codes of ethics serve three main aims: (a) to make sure high standards of practice, (b) to ensure public safety and (c) to lead practitioners in their making decisions.

What is required in education is a code of ethical conduct to guide teacher behavior both inside and outside the classroom. Such a code should be based on certain core principles and include banning definite actions and guidelines for decision-making when these prohibitions conflict. A code of ethics was created by the

American Educational Research Association (AERA) to serve as a guide for researchers in their work (American Educational Researcher, 2011). However, there are no clear guidelines for practicing teachers in their decision-making processes.

Moreover, “carelessness in teaching” is relevant with ethical issues in educational assessment. A few examples related to this factor are “starting the lesson unprepared” and “returning student papers without identifying mistakes”. In addition to them, “subjectivity in grading/teaching” is identified as an ethical misconduct. Examples related to that include “raising grades due to parental pressure” and “rewarding or punishing students based on student popularity”. Teachers believe that carelessness infractions are the most common and least significant transgressions, whereas boundary violations are the least often and most serious. The aim of this study is to extend previous research regarding ethical standards and obligations in educational assessment.

The existence of moral and ethical conflicts in the profession of teaching is examined in light of the fact that these problems are directly experienced and defined by teachers. In this regard, the goal of ethical conflicts in teaching is to outline the moral traps that the field presents. Nevertheless, there are currently no comparison studies comparing various teacher groups and their approaches to ethical standards. Teaching is a complex and demanding profession that requires constant ethical decision-making due to teachers' relationships with the young people they are responsible for and educate. Reasons for this complexity include lack of time, the need to act on the spot, and societal expectations to perform, which provide limited opportunities for ethical choices (Van Maanen, 1995). The variance of targets and tasks makes it hard to discern ethical elements in interactions with students. To achieve this goal, ethical conflicts in teachers' relationships with students, parents and colleagues can be examined. Teachers' subjective perceptions of

ethical dilemmas and issues should also be connected to the school's institutional background. Finding the causes of teachers' ethical dilemmas and the other choices they make is crucial. According to these goals, it is possible to construct questions about the professional ethical conflicts that instructors face, their characteristics, the norms that are at odds, the times when these situations arise, and the particular conditions that lead to these conflicts.

Teacher ethics has been addressed in educational research since the mid-1980s, but examples of empirical studies are limited because moral phenomena are frequently addressed in the context of education or moral philosophy. Existing empirical research suggests that teachers are unaware of the moral implications of their practices (Jackson, Boostrom, & Hansen, 1993) and risk suspending their sense of moral responsibility by compromising their own ideals (Campbell, 1993). Moreover, teachers differ in their solutions to ethical challenges according to the level of accountability and inclusion of others (Oser, 1989). It has also been concluded that teacher education does not sufficiently contribute to the improvement of teachers' awareness of ethics (Bergem, 1993).

The moral aspects of teaching and the necessity of enhancing teachers' ethical competences are highlighted by several scholars of educational philosophy. The power and duties of instructors in their connections with students are examined in this topic, along with the possibility of abusing this power (Strike, 1995). Since teachers' behaviors in the classroom are beyond the control of others, it is also stressed how important it is that they exercise self-control (Terhart, 1998). The fact that students in the school system have to be present there is another element that increases teachers' ethical responsibilities. The government is obliged to ensure that students are treated well; otherwise it cannot provide a justification for parents to send their children to school (Bergem, 1993; Soder, 1990).

It is also important that teachers must have public confidence in their work, and arguments in favor of the development of teacher ethics include concerns for both students and the teaching profession (Sockett, 1990).

Fenstermacher (1990) emphasizes the similarities as well as differences between teaching and other professions. While teachers cannot maintain social distance in their relationship with students, other professionals can. The teaching profession stands out as a field that requires effort from both teachers and students in order to be successful in learning. Service recipients may dedicate themselves to the professional's care in various occupations. Furthermore, there are parallels between the teaching profession and other occupations; the teacher-student relationship is marked by reliance and inequity. Professional behavior cannot be standardized or controlled, so teachers have to decide independently when making ethical choices. Both the freedom to act with tact and the freedom to act on one's own judgment require discretion in teaching.

Teaching professionalism can be considered as the integration of skills and knowledge and the awareness of moral responsibilities towards individuals who depend on the teacher. Internal inconsistencies inside the school might be used to discuss ethical issues in teaching. A "dilemma language" was created by Berlak and Berlak (1981) to characterize the dilemmas that educators encounter on a regular basis. These problems have a variety of solutions, despite their generality. The implicit curriculum of socialization and its implications for instruction are highlighted by Jackson (1968). Teachers are required to accomplish competing objectives in their work, which places two or more responsibilities on the school and its students. Jackson (1993) argues that although teachers are expected to be kind and considerate, they should also be demanding and strict when necessary. It is also emphasized that teachers should

be sensitive to the needs of individual students, not neglect the integrity of the classroom and maintain discipline and order.

Ethical dilemmas may be present in teaching profession, but they may not always be perceived or labeled in ethical terms. When it is necessary to summarize previous research and literature, teacher ethics and especially teachers' moral challenges are recognized as phenomena that are intrinsic in teaching and not always easily distinguished. In this study, an ethical rationality will be used to analyze the conflicts in teachers' work, which will enable the illumination and reflection of the ethical elements in the events described. Darling-Hammond (1985) states that it is unethical for teachers to comply with practices that harm children. However, the study concludes that teachers are left with no choice but to take such actions because of policies that are pedagogically inappropriate for some or all students. Although they cannot avoid them, teachers can cope with ethical conflicts in a variety of ways, depending on their awareness and capacity to discern between options and justifications for their conduct.

Ethical principles in education are important to ensure that teaching and assessment processes are fair, reliable and valid. While there are institutional codes of ethics for many professional groups, in education there are only ethical codes such as the Code of Fair Testing Practices in Education, developed by the Testing Practices Committee in 1990, and the “Standards for Student Assessment” developed by the Joint Committee on Standards for Educational Evaluation in 2003. These ethical codes address issues under four main headings: (a) test development and selection, (b) test administration and evaluation, (c) reporting test results, and (d) providing feedback to students. For the realization of ethical principles in education, the following ethical issues should also be considered:

- Can the evaluator access information and how should this information be evaluated? This question has both ontological and epistemological dimensions.
- Should the evaluator move away from their values during the evaluation? How can value conflicts be resolved?
- Which assessment technique should be used to ensure that students have fully understood the subject matter? This is a question that focuses on assessment methods.

Addressing similar issues related to assessment in education, Bazvand (2023) investigated the ethical dimension of assessment and measurement practices in teacher education programs. The results of the study revealed three main problems that violate ethical principles in education:

- Content validity issues (e.g. questions not being inclusive enough or asking questions that are off-topic),
- Ethical issues that arise during implementation (e.g., inconsistent behavior of testers and implementation conditions),
- Problems in the feedback process (e.g. non-transparent feedback provision or lack of assessment as specified in the curriculum).

Participants also reported that assessment practices were summative only and that there was no evaluation and feedback throughout the process. For the full realization of ethical principles in assessment and evaluation processes, Kunnan (2013) draws attention to three key concepts: (a) validity, (b) fairness, and (c) justice. Kunnan's (2013) Principles of Validity, Fairness and Justice were developed to address issues of ethics and equity, particularly in language testing and assessment processes. These three basic principles can be defined as follows:

- Validity: It refers to making sure that an assessment accurately measures what it is intended to measure. A valid test should be scientific and objective in assessing relevant knowledge or skills. For example, a language test should actually measure a learner's language skills.
- Fairness: It ensures that all participants have equal access to the test conditions. In a fair assessment process, accommodations are made for the different social, cultural and linguistic backgrounds of the participants. Each individual should participate knowing that the assessment will be fair.
- Justice: It includes processes that prevent discrimination and ensure equal opportunity among participants. According to this principle, participants should not be treated unfairly in the preparation, administration and use of the results of the test. All stages of the test should be evaluated within the framework of social justice.

Kunnan (2013) emphasizes the importance of fairness as one of the ethical principles and raises the following questions:

- Does every individual have the right to a fair test?
- What are the harms that an unfair test can cause to individuals?
- Should the state and relevant institutions support test takers' demand for a fair test?
- Should the test benefit the society in which it is used?
- Should test-developing organizations be obliged to disclose the psychometric properties of tests to the public?

Estaji (2011) argues that the assessment process should be fair across gender and cultural groups, emphasizing that the education system, and in particular decisions about students, should be dynamic and open to innovation. Kunnan's study emphasizes that these principles are of great importance in test design, administration and interpretation of results, and that language tests in particular should be aligned with social responsibility (Perrone, 2006; Sireci, 2013).

Kunnan, who has done significant work on language test fairness and ethics, questions the fairness, equity and cultural sensitivity of tests. Within this framework, he asks questions like:

- Do the tests fairly address all participants from different language backgrounds?
- Are all candidates given equal opportunities or are certain groups advantaged or disadvantaged?
- Do test questions contain content that misrepresents or discriminates against certain cultural or linguistic groups?

Ethics in assessment is recognized as an integral part of teacher education. Bazvand (2023) examined the perceptions of pre-service teachers participating in university-based teacher education programs in Iran towards ethics in assessment. Bazvand's study investigated whether pre-service teachers perceived the assessment practices of instructors as ethical. The findings revealed that the assessment system in Iran is mostly based on exams and theoretical knowledge and alternative assessment methods (such as peer assessment, self-assessment, portfolio assessment) are not common. In addition, pre-service teachers stated that they felt deficiencies in the evaluation process such as communication and fair evaluation. The educational culture in Iran has a more authoritarian approach and does not encourage students to actively participate in the

assessment process. Based on the participants' responses, three main problems related to ethics in assessment were identified:

Preparation: Under-representation of content, one-dimensional assessment and surprise items.

Implementation: Time, noise and inconsistencies in educators' behavior.

Grading and Communication: Lack of transparency in providing feedback, misorganization of grading practice and breach of confidentiality in grade communication.

It was also found that assessment was largely teacher-initiated and summative-oriented.

Buzzelli (2018) proposes the “ability principle” to ensure fairness in education. This principle emphasizes that assessment tools should take into account not only the knowledge and skills that students possess, but also the opportunities offered by their environment. It is well known that there are two main factors that shape people's intelligence, personality and many other psychological traits: (1) genetic inheritance and (2) social environment (Hammond, 2011). Therefore, besides the student's capacity to learn, organizing assessment tools in a way that takes into account the opportunities provided by his or her environment can help to ensure full justice. In particular, universal design is used in testing for students with special educational needs or marginalized groups. The ability principle argues that this approach should be extended further for all students. This principle is particularly important in younger age groups, as the opportunities provided by the family can make a significant difference at a young age, while students can make up for this difference as they get older.

Focusing on the concept of equity, Gipps (1995) poses the following questions:

- What knowledge is being assessed and is this knowledge an indicator of achievement?
- Is the scope and form of the assessment tool appropriate for different groups of individuals?
- Given each individual's values and cultural background, does this affect the way students respond to assessment and evaluation tools? Are measures taken in this regard?

Wall, Hursh, and Rodgers (2014) suggest five key responsibilities for individuals involved in the assessment process:

- Individuals involved in the assessment process should acknowledge the ethical nature of their work and adjust their roles accordingly.
- Be transparent about the purposes of the evaluation, for example, the purpose of the evaluation and the use of the results should be clearly communicated to stakeholders.
- Be transparent with all stakeholders about the methods used in the evaluation process and who has access to the data.
- Select appropriate evaluation methods and pay great attention to this selection.
- Provide feedback on the findings and the quality of the evaluation process in an interpretive way, taking responsibility for interpreting what the results communicate about teaching or students, rather than leaving it to stakeholders.

Especially in classroom evaluation processes, problems related to ethical principles may arise. This can divide the teacher community and society (Green et al., 2007). However, determining ethical principles to be used in education, especially in classroom

assessment, and implementing fair practices will create a sense of trust among all stakeholders. Some researchers argue that teachers may not always be consistent and make the right decisions on ethical issues. For that reason, providing teachers with a list of ethical codes to guide them in their assessment and evaluation processes is thought to facilitate their work.

In this context, Green et al. (2007) conducted a study to test the consistency in ethical issues in assessment among educators. The study found that there was disagreement among educators on more than half of the ethical issues. This shows the necessity of ethical codes in educational assessment and the need for teacher training to make these codes a skill among teachers and educators.

The professional educator considers success not only in terms of the realization of the student's personal potential, but also how student acts as a citizen of society. The educator treats each student fairly and tries to resolve disciplinary issues in accordance with the law. At the same time, he/she refrains from deliberately humiliating a student and always maintains a respectful attitude. They refrain from sharing confidential information about students, unless required to do so by law, and accordingly value confidentiality. Furthermore, the educator endeavors to protect students from conditions that are detrimental to learning, health or safety. They adopt an objective approach without bias or self-interest in conveying facts (Kunnan, 2013).

The selection of fair and appropriate assessment methods for different age and cultural groups within the framework of ethical principles is the key to success in education. It is extremely important that the methods used in this process take into account the developmental process and cultural background of each individual (Kunnan, 2013). The table below shows appropriate assessment methods for different age groups.

Table 1. Assessment methods according to age groups

Age Groups	Assessment Methods
Early Childhood (3-7 years)	The most appropriate assessment methods for this age group are play-based and observation-oriented approaches. Structured in accordance with children's learning style, portfolio assessment responds to the developmental level of this age group in a flexible and inclusive way (Puckett & Black, 2000).
Middle Childhood (8-12 years)	During this period, project-based and problem-solving assessment methods may be preferred as students develop more complex thinking skills (Gronlund, 2006).
Youth and Adults	At the university level, more analytical and in-depth assessment methods, structured methods such as written exams, oral presentations and group work come to the fore (Brookhart, 2010).

Compiled by the researchers.

In many schools and classrooms today there are students from different groups and backgrounds. Assessment methods in culturally diverse classrooms should be fair and free from bias. It is important to adapt assessment tools to take into account language barriers and different learning styles (Wiliam, 2010). The exclusion of interculturally sensitive questions is an ethical approach in this process (Natriello, 1987). On the other hand, in classrooms with language barriers, assessment materials need to be simple, clear and comprehensible; approaches that take cultural differences into account (Kunnan, 2013). In particular, using assessment methods in the mother tongue can increase fairness and accuracy (Tannenbaum, 2013). Individual learning differences should also be taken into account by using methods that address students' different types of intelligence. This ensures an assessment process that is both age and culturally sensitive (Gardner, 1983).

Fair assessment and evaluation tools for different age and cultural groups should fairly measure the potential of each individual. Students' needs and characteristics should not be ignored in the assessment process (Brookhart, 2010). Confidentiality of

assessment results is also extremely important in terms of protecting student privacy. Students' rights concerning privacy should be respected ethically in assessment processes (Kunnan, 2013).

Educators engage in social relationships with their target audience. For this reason, their job is similar to what psychologists do. Ethical codes identified by the American Psychological Association (APA) include the basic ethical principles and standards that psychologists should follow in their professional work. APA's Code of Ethics and Code of Conduct, updated in 2017, is based on these five core principles:

- *Fidelity and Responsibility*: Psychologists should be reliable and responsible in their professional relationships and fulfill their professional responsibilities within an ethical framework. They should not forget their responsibilities towards their colleagues, society and the organizations they work for.
- *Respect for People's Rights and Dignity*: Psychologists should respect the dignity, rights and privacy of every individual. Discrimination based on factors such as race, ethnicity, gender, sexual orientation, age and religion should be avoided.
- *Integrity*: Psychologists should be honest and sincere in their work and professional relationships. Behaviors such as providing misleading information, misdirection or deliberate misinformation should be avoided.
- *Beneficence and Nonmaleficence*: Psychologists should strive for the good of those they work with and avoid harming them. They should continuously evaluate the benefits and harms of professional interventions.

- *Justice*: Psychologists should treat everyone fairly and equally and use their professional expertise, experience and knowledge objectively. Precautions should be taken to prevent professional prejudices and inadequacies from leading to injustice.

These principles guide how psychologists should act when faced with ethical dilemmas and form the basis of their professional responsibilities. Teachers devote a large part of their time to educational assessment and evaluation activities in education and training processes (Crooks, 1988). Especially in the case of ethical dilemmas (Alkharusi, 2016; Schmeiser et al., 1995) in the development and implementation of measurement tools and educational evaluation processes, validated and applicable guidelines are needed. Ethical principles in measurement and evaluation in education guide teachers about the behaviors that should be preferred in the face of dilemmas experienced in practice (İlhan et al., 2017; Schmeiser et al., 1995).

Model Proposal Regarding Ethics in Measurement and Evaluation in Education

Purpose of the Model

This model, which focuses on ethical principles in measurement and evaluation processes in education, focuses on solving the following problems:

- Ensuring impartiality and fairness in educational assessment and evaluation processes.
- Protecting the rights and privacy of students based on the principle of first “Do no harm!”

- To consider ethical principles in the development, implementation and updating of assessment and evaluation tools.
- To be able to interpret and share measurement results in an ethical framework.

Ethical Principles in Measurement and Evaluation Processes in Education

Ethical principles provide basic guidance for practitioners to carry out measurement and evaluation processes in a reliable, fair and effective manner. The table below shows the ethical principles recommended in the measurement and evaluation processes in education within the scope of this study and their explanations.

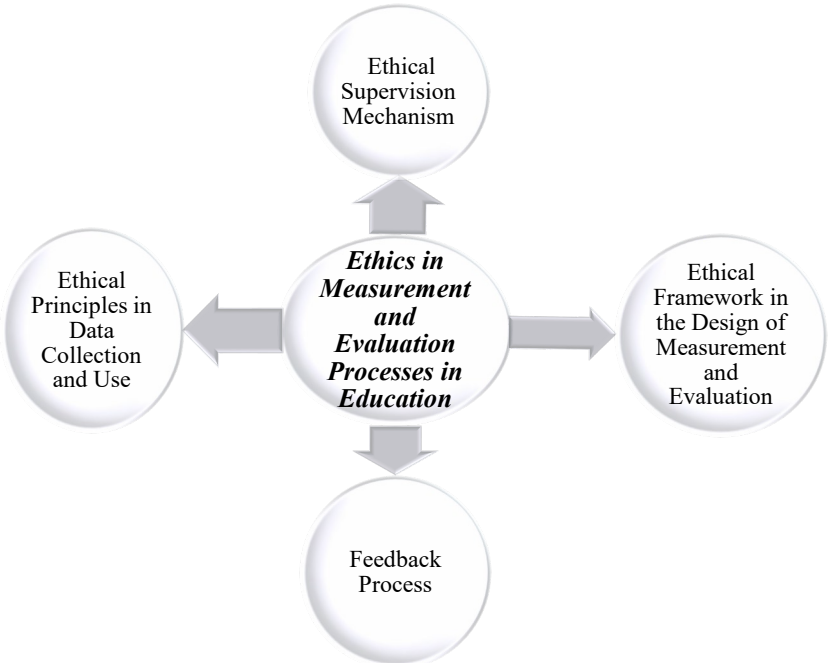
Table 2. Recommendations for ethical principles in measurement and evaluation processes in education

Ethical Principles	Explanation
Fairness	Transparent and equal application of assessment criteria for all.
Privacy and Security	Protecting the confidentiality of student data.
Unbiased attitude	Avoidance of bias in the assessment process.
Accuracy	Making sure that measurement tools are valid and reliable.
Transparency	Transparent sharing of results, process and methods.
Effective Feedback	Providing quality and timely feedback to students to support their development.

Components of the Model

The functionalization of an ethical model in measurement and evaluation processes in education depends on the qualified design of four basic components. These components are presented in

Figure 1. Ethical Principles in Measurement and Evaluation Processes in Education



a. Ethical Supervision Mechanisms

Ethical supervision mechanisms function as a systematic control structure to ensure that assessment and evaluation processes are carried out in line with ethical principles. Such mechanisms strengthen compliance with ethical principles by auditing every stage of assessment and evaluation processes. In this context, an audit board, commission or algorithm can be established to review assessment processes from an ethical perspective. These oversight mechanisms would be responsible for checking compliance with ethical principles in the development and implementation of assessment tools and the sharing of results.

b. Ethical Framework in the Design of Measurement and Evaluation

Following an ethical framework in the measurement and evaluation design aims to ensure that this process is fair, transparent, reliable and accessible. In line with the ethical framework developed within the scope of the model, first of all, measurement tools are developed, and standardization and validation methods are applied to ensure that the measurement tools are unbiased. In this context, explicit consent should be obtained from the participants before the application, and privacy and data security should be ensured. In addition, measurement tools suitable for the needs of disadvantaged groups should be developed.

c. Feedback Process

In the proposed model, assessment results are expected to be presented to students and stakeholders in an ethical manner. In this context, it is important not to use humiliating or discriminatory language in feedback, to obtain individual consent and to protect personal data.

d. Ethical Principles in Data Collection and Use

In addition to collecting and using data only for specified purposes in measurement and evaluation processes, efforts should be made to prevent algorithmic biases when using artificial intelligence or other digital tools.

Implementation Process of the Proposed Model

In each step of this phase, which includes certain steps for the effective implementation ethics in assessment in education, it is aimed to create a fair system by considering the rights of teachers, evaluators and students. The steps to be followed in the implementation processes of the model are addressed below.

Preparation and Training

In the training and preparation process for practitioners, it is aimed to raise awareness by first providing information about ethical principles and basic rules of measurement and evaluation. The content of the training includes solution suggestions for ethical problems that may be encountered in assessment processes. At this stage, the ethical rules to be considered in measurement and evaluation activities are also recorded in written form.

a. Defining Ethical Criteria

In this step, it is expected to determine the ethical criteria that will guide the assessment and evaluation processes. An example of these criteria is “Students' gender and ethnic origin will not be taken into account in assessment and evaluation studies.”

b. Development of Measurement Tools

Developing measurement tools in accordance with ethical principles will increase the reliability of the whole process. In this step, measurement tools such as tests, questionnaires and observation forms undergo an ethical audit. An independent ethics committee confirms that the tools are non-biased, non-discriminatory and objective.

c. Sharing Results in a Transparent and Ethical Way

Sharing assessment results in an ethical and transparent manner will contribute to building trust. In this step, assessment and evaluation results are shared only with the parties involved in the process or directly affected by the results. Such a principled approach will ensure respect for students' privacy and individual rights. On the other hand, the results should be explained in plain language and in a way that parties can easily understand.

d. Continuous Observation and Improvement

The implementation and effectiveness level of the proposed model should be reviewed regularly and efforts should be made to improve it. In this step, the level which the proposed model meets the targeted standards is identified and feedback is received in this context and necessary updates are made by identifying the defects in the process. The continuous improvement cycle will support the proposed model to remain current and functional.

Sample Implementation and Tools

The concrete implementation of an ethical assessment and evaluation process depends on the development of effective tools. These tools will contribute to making the whole process systematic, transparent and effective. At the same time, these tools help to strengthen ethical assessment and evaluation in practice as well as in theory. For example, ethical assessment rubrics make it possible to objectively evaluate assessment efforts, while student and teacher questionnaires will feed the feedback loop. Supporting digital systems can provide solutions to important sources of ethical concerns such as data security and anonymity. These best practices contribute to the systematic and successful implementation of the model in education.

It is important to clearly define ethical codes in the field of education so that all stakeholders abide by them. These codes should include basic principles to guide the behavior of educators and evaluation experts (Forster and Maxwell, 2023). In establishing ethical codes, the needs of different age and cultural groups should be taken into account and the applicability of these codes should be ensured. Teachers and other education professionals should receive comprehensive training on ethical values and appropriate assessment methods. This should include how to overcome ethical dilemmas, how to create fair assessment processes, and how to respect student privacy. In addition, educators should be kept up to date by providing

continuous professional development opportunities (Watts, 2020). Transparency of assessment processes increases the trust of all stakeholders. Students, parents and other interested parties should have access to clear information about assessment criteria and results. In addition, accountability mechanisms should be established for how assessment results are obtained, thus ensuring fairness and reliability of the process (Gündüz and Göker, 2017). In addition to assessment results, it is critical to provide constructive feedback to students. Feedback should be clear, understandable and instructive in order to support students' development. This process will help students evaluate their own learning process and develop their self-assessment skills. Cultural sensitivity in education needs to be increased to meet the needs of students from different cultural backgrounds (Dutar and Karataş, 2018). It should be ensured that assessment methods reflect cultural diversity and fairly measure the potential of each individual. This will contribute to ensuring equity and fairness in education. When using digital assessment methods, the confidentiality and security of student data should be ensured. Ethical use of technological tools can increase the transparency of assessment processes (Elleuch, 2024).

Furthermore, teachers and students should be trained on how to use these tools. Ethical assessment processes in education need to be continuously reviewed and improved. This allows educators to update the processes based on their experiences and the data obtained. Continuous evaluation helps to adapt to the dynamic nature of the education system.

Conclusion

Assessment in education should be designed to serve a specific need. Accordingly, it is important that the findings provide accurate and useful information to curriculum developers to improve processes and outcomes. Stakeholders should be consulted

throughout the assessment and ensure that the objectives, activities and findings of the evaluation meet the needs of all relevant groups. Existing codes of ethics in educational assessment aim to ensure fair, accurate and impartial processes. In particular, they provide guidance on how teachers and educators should behave in evaluation processes. The main ethical principles are as follows:

Validity and Reliability: Assessment should accurately and consistently measure student knowledge and skills. Misleading or inaccurate assessment methods should be avoided.

Fairness and Impartiality: Every student should be assessed on equal terms. It is essential to avoid discrimination and to be fair to students' social, economic or cultural backgrounds.

Privacy and Confidentiality: Students' assessment results must be kept confidential and shared only with relevant persons. Students' privacy must be respected.

Honesty and Transparency: Assessment criteria and processes must be clear and students must be informed about these processes. Results should be presented transparently and explanations should be made.

Feedback: It is important that assessment results are accompanied by constructive feedback. Clear and guiding feedback should be provided for students' development.

Lack of Cultural Sensitivity: It has been criticized that educational assessments are not sensitive enough to students' cultural backgrounds. Universal criteria may not be fair to students from different cultural and linguistic backgrounds.

Inadequate Feedback: Assessment processes often focus only on grading and lack developmental feedback. Students may not fully understand the reasons for their grades and how they can improve.

Exam Focus: In most education systems, assessments are based solely on students' exam results. This may ignore students' creative and critical thinking skills and may not fully reflect their development.

Overload and Stress: Test overload can cause stress in students and prevent them from showing their true abilities. This psychological pressure created by assessment processes has been criticized from an ethical point of view.

Privacy Issues of Digital Assessment Methods: Especially in digital assessments, the lack of adequate protection of students' personal data emerges as an important ethical problem. It can be said that clearer rules and practices are lacking in this regard.

As a result, ethical improvement of assessment processes in education will be possible by adopting methods that are more fair, inclusive and supportive of student development. The proposed model within the framework of this study is expected to contribute to the measurement and evaluation processes in education.

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CHAPTER 5

THE EFFECT OF THE COOPERATIVE CATALYST METHOD ON THE MICRO LEVEL STUDY OF CHEMISTRY TOPICS ON ACADEMIC ACHIEVES

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Introduction

Education plays a vital role in shaping the future of individuals and societies. Chemistry education, in particular, contributes to the development of scientific literacy, problem-solving skills, and critical thinking among students. However, traditional methods of teaching chemistry often fail to fully engage students or address the diversity of learning styles found in classrooms. This challenge has led educators and researchers to explore innovative strategies that enhance learning outcomes and develop a deeper understanding of the subject.

Chemists refer to chemical phenomena at three different levels of representation (macroscopic, symbolic, and microscopic)

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that are directly related to each other. The macroscopic level is the observable chemical phenomena that students experience in their daily lives, such as observing colour changes, the formation of new products, and the disappearance of others. To communicate about these macroscopic phenomena, chemists often use the symbolic level of representation, which includes pictorial, algebraic, physical, and computational forms such as chemical equations, graphs, reaction mechanisms, analogies, and model kits(Hamerská et al., 2024; Laohapornchaiphan & Chenprakhon, 2024). The microscopic representation, based on the particle theory of matter, is used to explain macroscopic phenomena in terms of the motion of particles such as electrons, molecules, and atoms. These microscopic entities are real but too small to be observed, so chemists use symbolic representations to describe their properties and behaviours to create mental images. We can say that all three levels of representation are complementary in improving the understanding of the chemical concepts being studied (Ling & Cao, 2024). The role of each level of representation (macroscopic, symbolic, and microscopic) and the relationships between each level are often undertaken by chemistry teachers who use all three levels simultaneously. Furthermore, teachers often assume that students can easily move from one level to another. When comparing the perceptions of experts and novices of various chemical representations, it was concluded that novices use only one form of representation and rarely convert to other forms, whereas experts convert easily. Novices relied on surface features such as lines, numbers, and colours to classify representations, while experts used an underlying and meaningful basis for their classifications. Especially in subjects such as chemistry, biology, and physics, where students have difficulty, learning using different methods and techniques is both persistent and facilitative. For example, many tend to break down information into pieces and then memorize these pieces or algorithms; they also tend to focus on the surface features of a visual representation. In

contrast, scientists tend to use meaningful and productive learning strategies when working on a complex research problem. Scientists tend to use mental images and multiple representations of events when solving complex problems and can switch from one representation to another. Therefore, the goal of dynamic visualizations is to enable chemistry students to visualize on a computer screen (i.e., external representations) the same types of representations of chemical events that chemists mentally envision (i.e., internal representations). The design and use of visualizations in chemistry should focus on creating interactive learning environments that provide a range of goals, from explaining concepts to investigating chemical events. To achieve these goals, the instructional sequence should begin by specifying learning objectives that are sensitive to students' background knowledge of chemistry topics(Alasadi & Baiz, 2024; Uttal et al., 2024). It should result in assessments that go beyond mere recall while encouraging students to develop their own mental models. Throughout this process, instruction should support appropriate levels of student interaction while providing cues to direct students' attention, feedback to guide their learning, and scaffolding to facilitate information processing. Animations are often used to help students understand and explain abstract chemistry concepts, while simulations allow students to explore phenomena and their representations. One of the best ways to determine whether students have a conceptual understanding of chemistry is to what extent they can accurately express their mental models to solve relatively complex chemistry problems. A mental model is a set of mental representations and the mental operations that apply these representations to a particular problem. Mental models help students organize their experiences into meaningful cognitive structures that enable them to select and transform information and to generate hypotheses. Chemists often flatten chemical facts into a mental

model they use visual images to illustrate (Talanquer & Kelly, 2024; Toikka & Tarnanen, 2024).

In the context of chemistry education, the cooperative method is particularly promising. Chemistry is a subject that requires not only conceptual understanding but also the ability to apply theoretical knowledge in practical scenarios. The cooperative learning approach allows students to engage in active discussions, share different perspectives, and cooperative solve problems, which is crucial for mastering complex topics in chemistry. In addition, this method supports the development of essential 21st-century skills such as communication, teamwork, and adaptability. This method contrasts with traditional, teacher-centered approaches in which students primarily receive information in lectures and work individually. The cooperative approach emphasizes collaboration, peer interaction, and collective problem solving, making it an effective strategy for improving student engagement, understanding, and memory in chemistry. Unlike traditional passive learning methods in which students mostly listen to lectures, cooperative learning requires students to actively engage with the material. They are encouraged to discuss, question, and apply chemical concepts in real-world contexts. This active participation develops problem-solving skills and critical thinking abilities. One of the core principles of the cooperative method is shared responsibility. Each student has specific roles and tasks within the group, which contributes to the overall success of the team. This helps students develop both individual and collective accountability for their learning outcomes.

The cooperative method accommodates different learning styles. Some students may thrive on visual learning through diagrams, others may be auditory learners who benefit from discussing concepts, while others may learn better through hands-on experiments. Group work allows these diverse learning styles to

complement each other, leading to a more inclusive and effective educational experience. Students develop social skills such as communication, conflict resolution, and leadership through teamwork (Doymus, 2007; Doymus, 2008). These skills are important in chemistry education, as students are required to present their findings, explain complex concepts, or collaborate on laboratory tasks. The cooperative method emphasizes higher-level cognitive skills such as analysis, synthesis, and evaluation. For example, when working on a laboratory experiment or solving a complex chemistry problem, students must analyse data, make predictions, and evaluate results. This method encourages critical thinking and problem-solving skills, which are important in chemistry and other scientific disciplines. Classifications based on teaching method include teacher-centered education, where the teacher is at the center of providing information to students, and student-centered education, where students take a more active and responsible role in shaping classroom activities. For conscious education, learning and teaching occur with a clear purpose in mind. Unconscious education occurs spontaneously, without conscious planning or direction. This may occur in part through the personalities of teachers and adults, which may have indirect effects on the development of the student's personality. Visual education uses scientific studies to determine which educational methods work best. Its aim is to maximize its effectiveness by ensuring that educational practices and policies are informed by the best available empirical evidence.

Purpose of the Study

In this study, the Collaborative Catalyst Method (C2M) was applied to bring students to the center of teaching(Doymuş, 2023). The cooperative learning method is defined as creating an environment where students with different learning styles, abilities, interests and perceptions are formed in small mixed groups and work

towards a common goal on an academic subject, where students develop their communication, problem-solving and critical thinking skills and help each other learn, and their active participation in the process (Doymuş et al., 2004; Hennessy & Evans, 2006; Johnson et al., 1998). While education is moving towards an interdisciplinary approach in the 21st century, educational institutions must also keep up with this trend. For this reason, it is seen that some of the currently applied methods and techniques do not adapt to the system applied in the 21st century. For this reason, it is revealed that cooperative methods are an effective method. The method initiated by Doymuş in 2023 is the Cooperative Catalyst Method (C2M).

Research questions:

1. Is there a significant difference between the students' prior knowledge levels about particulate structure in chemistry in the research groups?

2. Do chemistry course activities conducted with C2M have an effect on students' understanding of the subject?

Methods

Research model/ Research Design

A quasi-experimental design with a pretest-posttest control group, one of the quantitative research designs, was used in the research. The purpose of scientific research is to measure variables and to use an experimental design to determine the cause-effect relationships between these measured variables In the experimental design, the application group is the experimental or control group selected with equal probability. A quasi-experimental design was used in the research (Büyüköztürk, 2012). Quasi-experimental designs are used more in educational research. Because the groups to be studied are determined in advance and only which group will be the experimental group and which group will be the control group

can be randomly selected. If a quasi-experimental design with one experimental and one control group is used, two branches of the school or two different groups in one branch can be used as the experimental and control groups. The factor whose effect is desired to be measured was applied to the experimental group, and in the control group, the application; lessons were conducted with the traditional method. The success of both groups was measured before and after the application.

Universe and Sample

The sample of the study consists of first-year students studying at the Department of Science Education of Atatürk University Kazım Karabekir Faculty of Education. A total of 33 first-year students participated. These students were divided into two groups. One of these groups was selected as the Experimental Group (EG) (n=20) where the Cooperative Catalyst Method was applied and the second was the Control Group (CG) (n=13) where traditional teaching was applied with a random method. The number of students in the groups participating in the application is variable and varies according to the students' attendance status.

Data Collection Tool

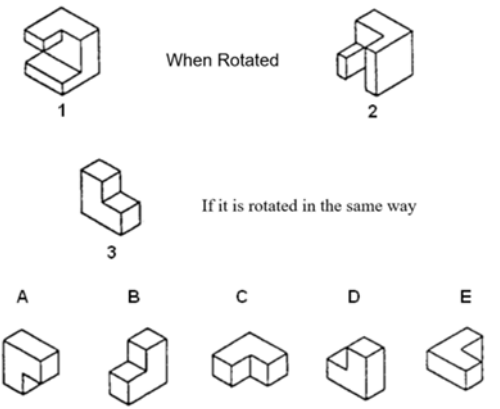
Spatial Visualization Test (SVT)

SVT was condSVTed as a pre-test and post-test to determine the spatial visualization skills of the students. SVT was created by translating the Purdue Spatial Visualization Transformation Test (PSVT-R) used by Bodner and Guay (1997) by Karaçöp (2010). SVT consists of 20 multiple-choice questions. In this study, 10 questions were selected and used. The reliability coefficient of this test was determined as 0.80 by Bodner and Guay (1997) using the KR-20 method. The following steps are recommended to be followed in answering SVT questions;

In the first step, first an object and its rotated version are presented. In order to obtain the rotated version of this object, it is necessary to determine in which direction the object is moving.

In the second step, a different object is presented and it is requested to determine how this object would look if it were rotated as in the first step. An example of the questions in the SVT is shown in Figure 1.

Figure 1 An Example of Questions in the SVT.



Source: Karaçöp (2010).

Particulate Nature of Matter Test (PNMT)

PNMT consists of 15 open-ended questions that measure students' understanding of the interactions in the formation of ionic and covalent bonds, the presentation of intermolecular interactions, the presentation of electron distributions of some molecules, and their micro (molecular) level understanding using Lewis dot symbols, considering some topics in basic chemistry. The structural and scope validity of PNMT was ensured by obtaining the opinions of three faculty members working in the chemistry department. The

answers given by the students to the questions in PNMT were examined in two main categories.

1) The answers given by the students to the questions in PNMT by making scientifically correct explanations and correct drawings were considered as scientifically correct understandings (understandings in a granular structure). The answers under this category were evaluated according to the scoring table given below and PNMT scores were calculated.

2) The answers given to the open-ended questions in PNMT were examined with the content analysis method and the answers regarding the misunderstanding of some concepts during the process of answering the questions were evaluated in depth. The students' granular drawings regarding the misunderstanding of the concepts were converted into written explanations. The percentages of the Conceptual Misunderstanding (CM) expressions derived from the students' incorrect answers were calculated separately for EG and CG among those who gave correct or CM answers and were presented in tables. In addition, drawing examples of CM expressions are provided below the relevant tables. Answers without scientific content and unanswered questions were not included in the evaluation process.

In the experimental group

The application of the Cooperative Catalyst Method (C2M) was developed by Doymus (2023) and developed in the 21st century. The C2M, which has been put into practice in century education and research, is applied in four main stages. The first stage is to identify the catalysts (unchanging people) involved in the study, the second stage is to form collaborative groups, the third stage is to identify the subjects, and the fourth stage is to carry out the implementation.

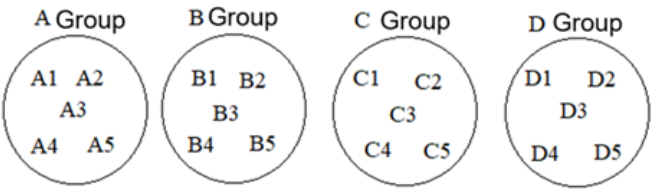
Identification of Catalysts

Catalysts are people who have been educated in the upper classes, who know the subject matter or are trained by teachers or researchers in the same class. Before the work begins, the catalysts' knowledge of the study subjects or disciplines to which they are assigned is determined. If there are any deficiencies in the information, they are corrected. Next, information is provided about the groups and the cond SVT of the study. Catalysts focus on their own subjects/disciplines. The catalyst helps the group and tries to eliminate the deficiencies seen in the group's work. Teachers or researchers, on the other hand, eliminate the deficiencies in the work of the groups and the contribution of catalysts to the groups. In this study, one person in each group was determined as a catalyst and the catalysts were trained on the subjects to be covered.

Formation of Cooperative Learning Groups

The researcher or teacher determines groups of 2-6 people, taking into account the number of students in the class, and creates heterogeneous groups by taking into account the level of knowledge of the students assigned to the groups for academic success. It then gives general information about what the groups should do in the working process. Each group designates group leaders, group announcers, and group rapporteurs as needed. It is also said that all students in the groups will actively participate in the learning process (Doymus, 2008). In this study, 4 groups of 5 students each were formed in the experimental group. The groups are shown in Figure 2.

Figure 2 Experiment Working Groups (Each of the symbols shown in the circle represents a student)

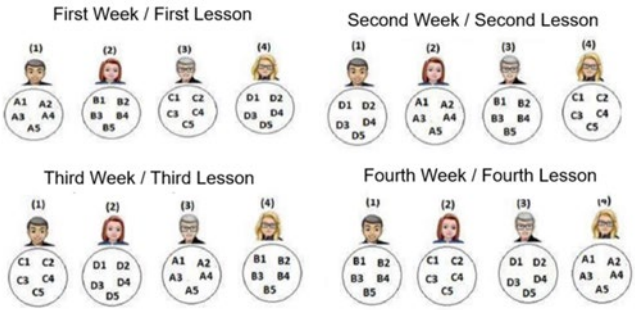


Source: Authors

Identification of Subtopics or Disciplines

The subtopics of the unit to be studied are divided into sections according to the number of collaborative groups formed in the class or study. If there are many collaborative groups, subtopics can be given to two groups. In addition, if the number of subtopics is high according to the number of groups, the subtopics can be combined under a single subtopic. The group students go to the relevant catalyst and start working on the sub-topics given to the groups. Materials related to subtopics are presented to students by the teacher. General information is given on how to work with subtopics. All groups are taken to the exams after completing the relevant sub-subject studies. In the 21st century, when a subject is studied interdisciplinary, they complete the interdisciplinary work by going to the catalyst related to that subject in each discipline. In this study, chemical bonds, states of matter, mixtures and the structure of the atom were discussed. The application study is given in Figure 3.

Figure 3 An Example of the Application of the Collaborative Catalyst Medot.



Source: Doymuş (2023)

In Figure 3, catalyst (1) is responsible for teaching chemical bonds, (2) catalyst is responsible for the states of matter, (3) catalyst is responsible for mixtures, and (4 Nlou) catalyst is responsible for teaching the structure of the atom. In the first week of the first week, each group takes its place in the learning of a sub-subject. After completing the necessary information, the groups continue to work by going to the catalysts in charge of the subject to learn about other topics in turn. In the fourth week, the learning of the subjects is stopped. (For example: In the first week, group A receives information from catalyst no. 1, in the second week, they take lessons from catalyst no. 2, and the other groups follow the same order). After the subjects were finished, SVT and PNMT were applied again as post-tests to both the experimental and control groups.

Implementation in the Control Group

The teacher is seen as the primary source of information and controls the flow of information. Lectures are usually delivered through indirect or direct instruction, and students are expected to absorb the material by listening. Learning is mostly passive for

students because the teacher presents information in a structure d format. This usually involves using textbooks, chalkboards, or slides, and students jot down or memorize the information provided. In this method, there is usually an emphasis on memorizing facts, formulas, or definitions. The learning process focuses more on repetition and recall rather than critical thinking or problem-solving. Since the teacher is the central figure, the interaction between students is limited. There are fewer group discussions or collaborative activities. Students are usually assessed on an individual basis on the basis of tests or exams that focus on remembering factual information. Ask about creating and managing teacher assessments...

The ethical process in the study was as follows:

- Ethics committee approval was obtained from Atatürk University University Educational Sciences Unit Ethics Committee (Date: 07.06.2024, Number: E-56785782-050.02.04-2400186124)
- Informed consent has been obtained from the participants.

Data Analysis

The data obtained in this study were evaluated quantitatively and qualitatively. SVT was calculated quantitatively and independent t-test was applied. Students' answers to the questions in PNMT were examined under two main categories. 1) The answers given by the students to the questions in the PNMT were evaluated as scientifically correct understandings (granular understandings) by making scientifically correct explanations and appropriate drawings. The responses of this category were examined according to the scoring scale given below and PNMT scores were calculated. 2) The answers given to the open-ended questions in the PNMT were examined by content analysis method and the answers about the

misunderstanding of some concepts were evaluated in depth. Students' granular drawings about misunderstanding concepts were converted into written expressions. The percentages of Conceptual Misunderstanding (QA) statements derived from students' erroneous answers were calculated and presented in tables for EG and QA separately among those who answered correctly or in the form of QA. In addition, examples of drawings of QA expressions are included below the relevant tables. Answers that do not contain scientific content and unanswered questions are not included in the evaluation process.

Results

In this section, the findings obtained in the research of the effects of C2M and traditional teaching methods in teaching the subjects of chemical bonds, states of matter, mixtures and atomic structure are presented.

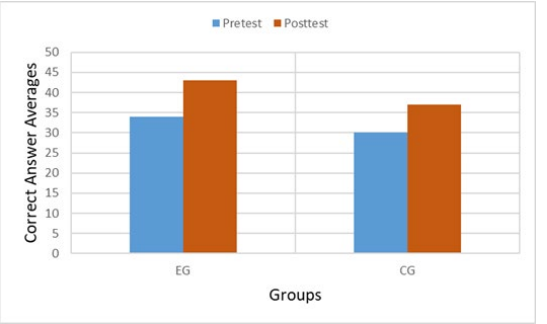
Findings Obtained from the Application of Chemistry Subjects

The research findings regarding the application of chemical bonds, states of matter, mixtures and atomic structure include the statistical analyses of the pre-test and post-test scores of the students participating in the research in SVT and PNMT and the findings and comments obtained from the content analysis of the answers given to the open-ended questions in PNMT (conceptual misunderstanding category).

Findings and Comments Obtained from SVT

The graphs of the mean scores obtained from SVT of the students in EG and CG participating in the application of chemical bonds, states of matter, mixtures and atomic structure are given in Figure 4.

Figure 4 The Average Correct Answer Scores of The Students in The Spatial Visualization Test.



Source: Authors

According to the graph in Figure 4, the mean SVT scores of the groups ranged from 30 to 43. Whether the SVT scores of the groups differed statistically was examined by independent t-test analysis and the results are given in Table 1.

Table 1 Independent Groups T Test Results on Pretest and Posttest Scores of SVT by Groups.

Testler		*N*	*X*	*SD*	*DF*	*T*	*P*
Pretest	*EG*	*20*	*34*	*20.6*	*31*	*0.617*	*0.541*
	CG	*13*	*30*	*12.8*	*31*		
Posttest	*EG*	*20*	*43*	*18.6*	*31*	*0.923*	*0.363*
	CG	*13*	*37*	*16.0*	*31*		

Source: Authors

According to the data given in Table 1; the independent sample t-test revealed that there was no significant difference between the two groups, we can say that there is not enough evidence to conclude that the mean values of the two groups are significantly different for the measured variable because the small number of students participating in the study indicates that the observed data do not provide strong enough evidence to reject the null hypothesis at

the chosen significance level (usually 0.05). A small sample can lead to a Type II error (not being able to detect a difference that actually exists). Even if there is no statistical significance, the effect size should be checked. A small but significant effect may still be valid in practical contexts. The results obtained when looking at the effect size of the scores are given in Table 2.

Table 2 Data Regarding the Hedges G Effect Size of the Scores Obtained from the SVT of the Groups Participating in the Study

Tests		N	X	SS	Hedges' g'si
Pretest	EG	20	34	20.6	0.219
	CG	13	30	12.8	
Posttest	EG	20	43	18.6	0.321
	CG	13	37	16.0	

Source: Authors

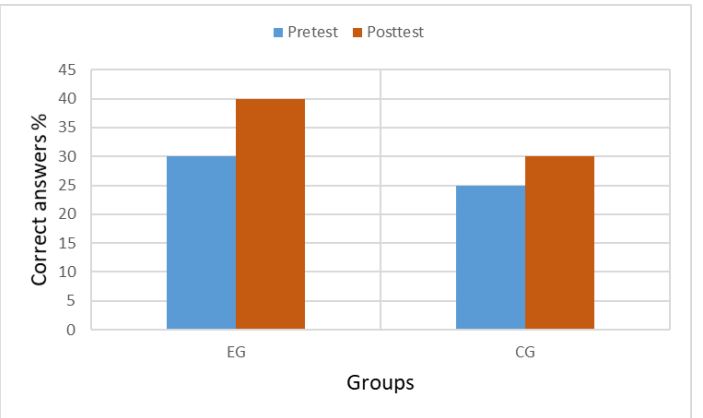
Glass's Delta and Hedges' G Cohen's d are appropriate effect size measures when the two groups have similar standard deviations and are of the same size. Glass's delta, which uses only the standard deviation of the control group, is an alternative measure if each group has a different standard deviation. Hedges' g, which provides a measure of effect size weighted by the relative size of each sample, is an alternative measure when there are different sample sizes (Hedges' g is used in this study). Hedges' g is a standardized effect size used to measure the magnitude of the difference between two groups in terms of their means and takes into account sample size bias. It is similar to Cohen's d but includes a correction for small sample sizes. In this study, the SVT pretest data were examined with Hedges' g. As a result of the examination, Hedges' g was g = 0.2. This indicates a small effect. Although there are some improvements, we can say that the new method only leads to a small

difference in students' performance compared to the old method. The difference is small and may not be practically significant. Although there is some improvement, this may be due to natural variability or small factors. Again, the SVT posttest data given in Table 2 were examined with Hedges' g. As a result of the examination, Hedges' g value is g = 0.3. This is a medium effect size, indicating a noticeable difference that is probably meaningful in practical terms. We can say that the students who received the new method showed a moderate improvement compared to those who received the traditional method. Furthermore, Hedges' g values can be contextualized depending on the field of study. In education, even a small effect can be significant due to the complexity of human learning.

When the Results Obtained in PNMT Are Evaluated on a Question-by-Question Basis;

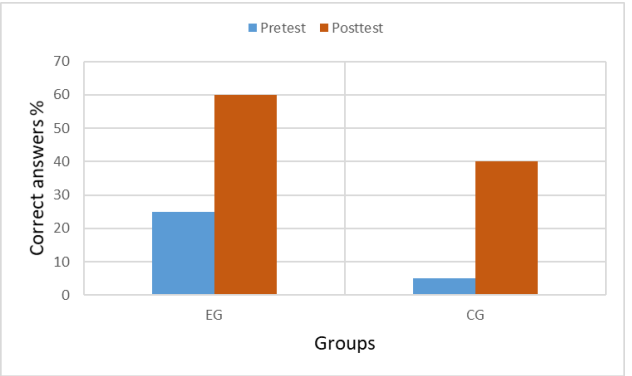
The percentages of correct answers given by students to questions 1, 2, 3, 4, 5, 6 and 7 related to chemical bonds are given in Figures 5, 6, 7, 8, 9, 10 and 11.

Figure 5 Percentages of Correct Answers Given by Students to the First Question of PNMT on Chemical Bonds.



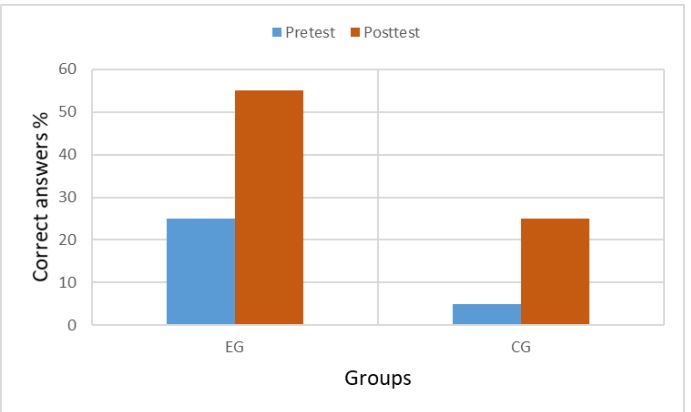
Source: Authors

Figure 6. Percentage of Correct Answers Given by Students to the Second Question of PNMT on Chemical Bonds.



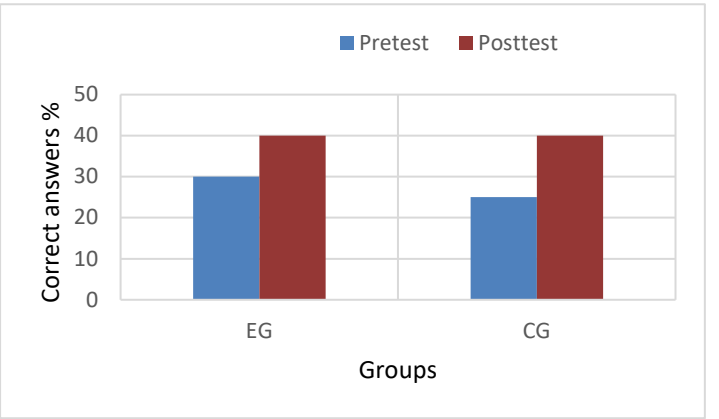
Source: Authors

Figure 7 Percentage of Correct Answers Given by Students to the Third Question of PNMT on Chemical Bonds.



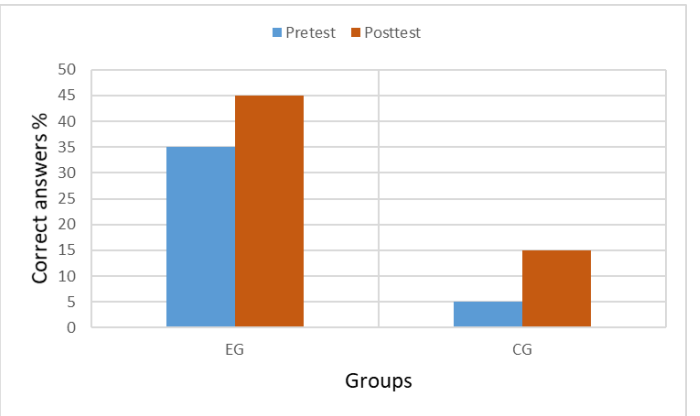
Source: Authors

Figure 8 Percentage of Correct Answers Given by Students to the Fourth Question of PNMT on Chemical Bonds.



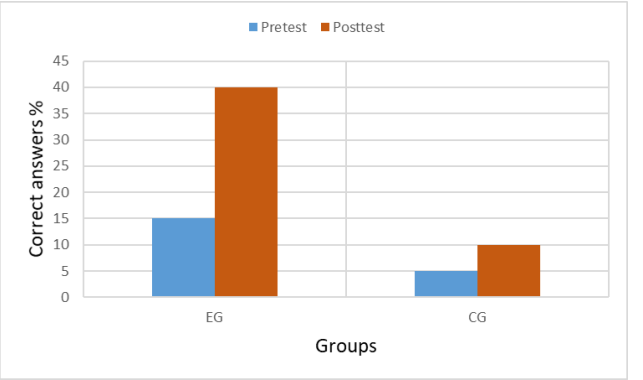
Source: Authors

Figure 9 Percentage of Correct Answers Given by Students to the Fifth Question of PNMT on Chemical Bonds.



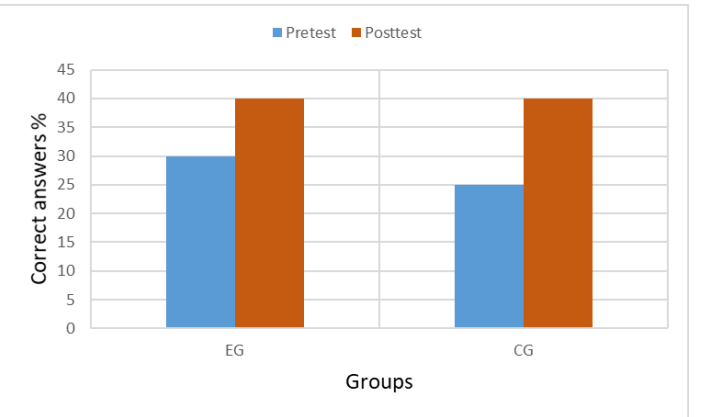
Source: Authors

Figure 10 Percentage of Correct Answers Given by Students to the Sixth Question of PNMT on Chemical Bonds.



Source: Authors

Percentage of Correct Answers Given by Students to the Seventh Question of PNMT on Chemical Bonds.



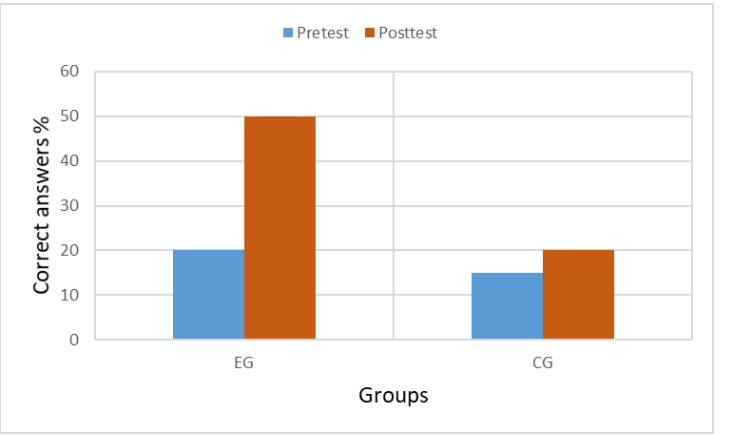
Source: Authors

When the graphs between Figure 5 and Figure 11 regarding the subject of chemical bonds are examined, it is seen that the percentages of answers given by both the experimental and control groups in the pretest are close to each other, but in the posttest, the experimental group students are partially successful compared to the control group. It is thought that several factors affect students'

difficulty in understanding or knowing the molecular size in chemical bonds. These are; students generally learn that ionic bonds involve electron transfer and covalent bonds involve electron sharing, but they may not fully understand how this affects the overall size of molecules. The size of molecules in covalent bonds depends on atomic radii and how atoms share electrons, while ionic compounds are related to the arrangement of ions in a crystal lattice rather than individual molecules. The distinction between individual atoms, ions, and molecules can be confusing and lead to difficulty in visualizing molecular size. In ionic bonds, there are no separate molecules, but instead a lattice structure, which makes it difficult to understand the concept of molecular size. Molecular sizes and shapes can be abstract concepts that are difficult to visualize without appropriate models or representations. Many students have difficulty grasping these ideas without clear visual aids such as 3D models, computer simulations, or molecular diagrams. Molecular size is not something that students can easily determine without a deeper understanding of concepts such as bond length, bond angles, or electron density. Covalent compounds have bond lengths that students can measure, whereas ionic compounds do not have distinct molecular dimensions because they are in large crystal lattices, making it difficult to define a "molecular" size. They are often taught with simplified models that do not emphasize the size differences between molecules formed with covalent bonds and ionic lattices formed with ionic bonds. This can lead to a gap in understanding when students later encounter the concept of molecular size. Students may confuse atomic radius (the size of individual atoms) with molecular size (determined by how atoms or ions are combined in a molecule or crystal). It can also be difficult to grasp the concept that ions are smaller or larger than their parent atoms, depending on whether they have gained or lost electrons.

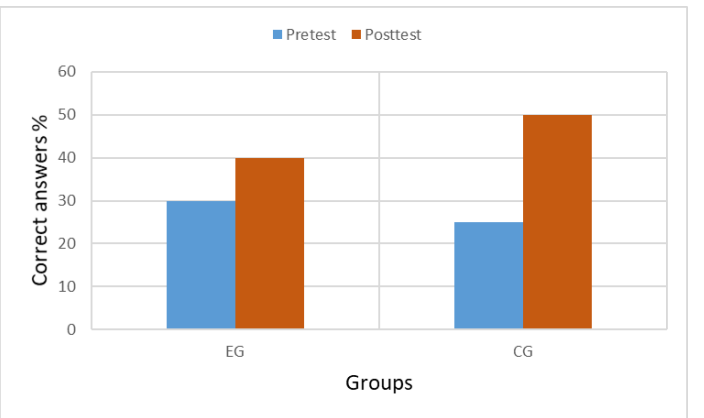
The percentages of correct answers given by the students regarding the dissolution topics of PNMT are given in Figures 12, 13 and 14.

Figure 12 Percentage of Correct Answers Given by Students to the Eighth Question of PNMT on Dissolution.



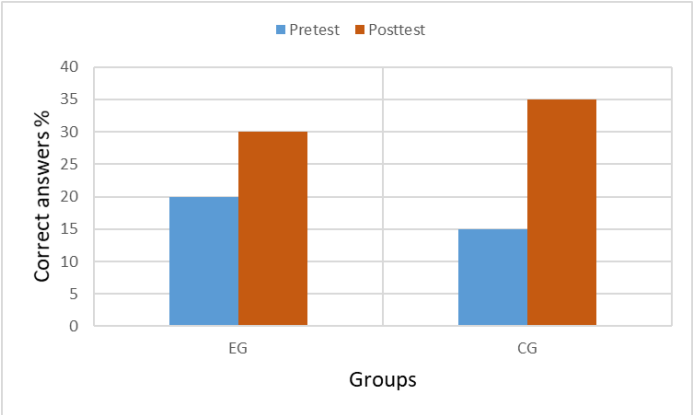
Source: Authors

Figure 13. Percentage of Correct Answers Given by Students to the Tenth Question of PNMT on Dissolution.



Source: Authors

Figure 14. Percentage of Correct Answers Given by Students on the Twelfth PNMT Dissolution Topic.



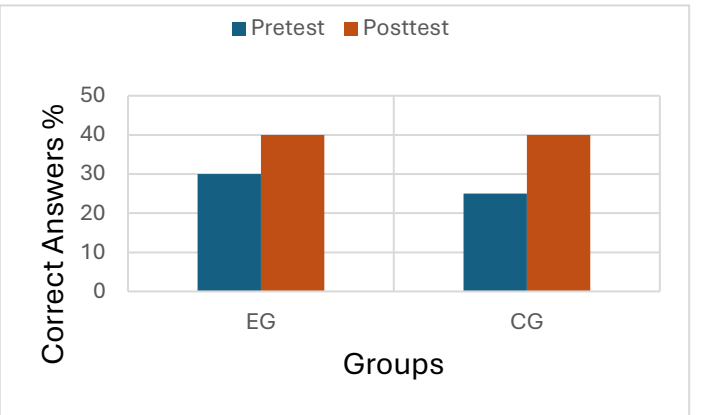
Source: Authors

When the graphs between Figure 12 and Figure 14 regarding the solution topic are examined, it is seen that the percentages of the answers given by the students in both the experimental and control groups in the pretest are close to each other, but in the posttest, the experimental group students are partially successful compared to the control group. As in the case of bonds, it is thought that there are some factors that reduce the success of the students in the solution topic. These are the molecular size, which is not something that students can directly observe, which makes it abstract. Students often have difficulty conceptualizing the size of molecules because they cannot be seen with the naked eye. In many curricula, especially in the early stages of learning about solutions, the molecular size is not emphasized enough. Instead, students often focus on broader concepts such as concentration, solubility, and solution types, and do not delve into the microscopic details of molecular dimensions. Without appropriate visualization aids, it may be difficult for students to grasp the scale of the molecular size. Models or simulations that allow students to see or manipulate virtual

molecules may not be used enough, which may limit their understanding. Students may believe that all solute particles are similar in size or that solutions are completely uniform. They may not realize that different solutes have very different molecular sizes depending on their molecular structure. Students may confuse molecular size with other properties such as molar mass, atomic radius, or even solubility. Without a clear distinction, they may not fully appreciate how molecular size affects solubility, diffusion, and the behavior of solutions.

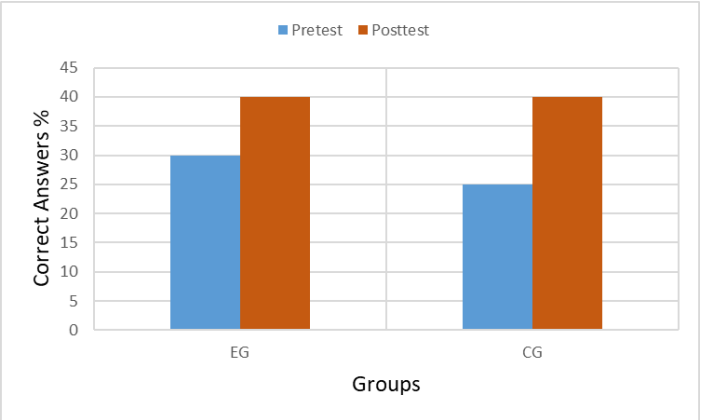
The percentages of correct answers given by the students regarding the phase change of matter topics of PNMT are given in Figure 15 and Figure 16.

Figure 15 Percentage of Correct Answers Given by Students to the Fourteenth Question of PNMT on the Subject of Phase Change of Matter.



Source: Authors

Figure16. Percentage of Correct Answers Given by Students to the Fifteenth Question of PNMT on the Subject of Phase Change of Matter.



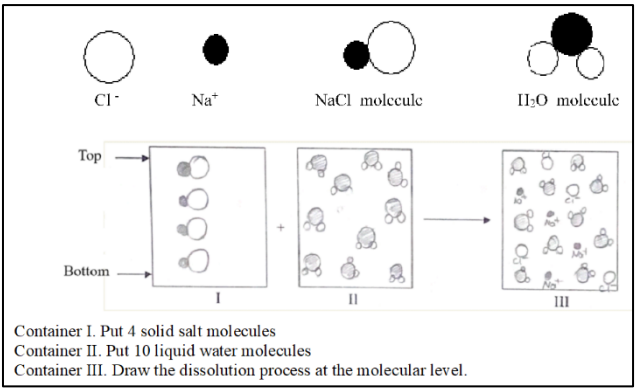
Source: Authors

When the graphs on the subject of the phase change of matter in Figure 15 and Figure 16 are examined, it is seen that the percentages of the answers given by the students in both the experimental and control groups in the pretest are close to each other, but in the posttest, the students in the experimental group are partially successful compared to the control group. It can be said that there are some factors that reduce the success of the students in the subject of the phase change of matter. These include a phase change from solid to liquid (melting) that students may not fully understand. They may not understand that the temperature remains constant during the phase change, and this may cause confusion when interpreting the flat part of the graph. Students may confuse the concepts of temperature and thermal energy. They may think that the temperature should constantly increase as the substance is heated, and they may not realize that energy is absorbed to break the bonds between molecules without increasing the temperature during melting. The melting graph reflects both theoretical knowledge and practical events. If students do not have practical experience or a

good visualization of the melting process, they may have difficulty relating the graph to what is actually happening at the molecular level. The flat part of the graph where the temperature remains constant can be particularly confusing. Some students may interpret this as an error or think that no process is occurring, rather than understanding that this plateau represents the energy required to change the phase of matter. Some students may lack confidence in analyzing and interpreting graphs in general. They may have difficulty identifying basic features such as slopes, plateaus, and what they represent in terms of physical processes.

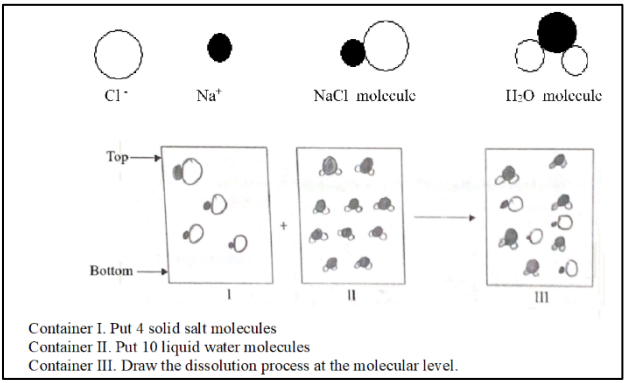
Some examples of drawings made by students are given in Figure 17, Figure 18, Figure 19, Figure 20 and Figure 21.

Figure 17 Correct Drawing Example for Question Eight of PNMT.



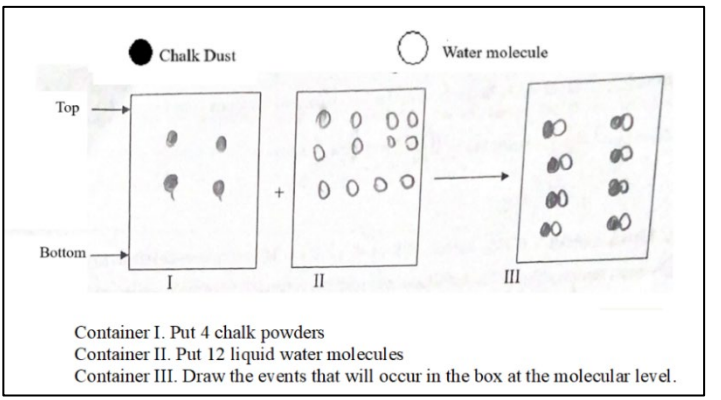
Source: Authors

Figure 18 Incorrect Drawing Example of Question Eight of PNMT.



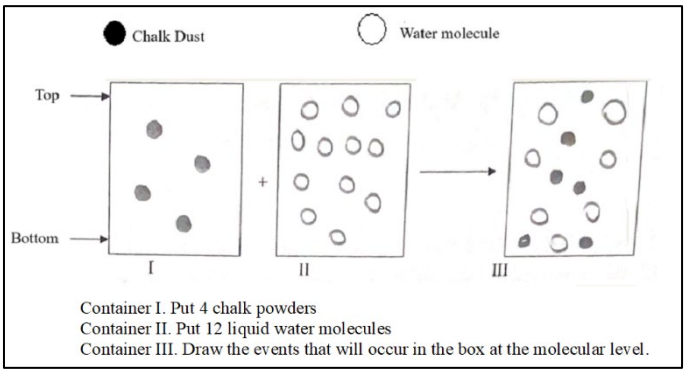
Source: Authors

Figure 19 Correct Drawing Example for Question Ten of PNMT.



Source: Authors

Figure 20 Incorrect Drawing Example of Question Ten of PNMT.



Source: Authors

Looking at the sample drawings in question eight, it appears that the vast majority of students have difficulty with the mechanism of dissolution at the microscale. This is because the dissolution process involves changes at the molecular and ionic levels that are difficult to visualize. Students may have difficulty conceptualizing how individual molecules or ions interact with solvents such as water and how they separate and disperse throughout the solution. Additionally, understanding dissolution requires a solid understanding of intermolecular forces (e.g., hydrogen bonding, dipole-dipole interactions, van der Waals forces) and how these forces affect the solubility of substances. Without a deep understanding of these forces, it can be difficult for students to predict how and why particular solutes dissolve in particular solvents. The primary reasons students have difficulty solving problems at the microscale are that breaking solute-solute bonds, breaking solvent-solvent bonds, and forming solute-solvent bonds, and the energetic issues involved in this formation, such as changes in enthalpy and entropy, can be complex to understand. Students often think of dissolution in terms of macroscopic observations that can be separated from the molecular scale, such as stirring or heating

a solution. Translating this to the behavior of individual molecules or ions requires an understanding of abstract principles such as the role of surface area, temperature, and concentration at the molecular level. Without visual aids or models (such as molecular dynamics simulations or 3D molecular models), students may have difficulty imagining how molecules behave in a solution. The molecular scale is too small to observe directly, making it difficult to connect theoretical concepts to real-world phenomena. When examining students' drawings in Question 10, it becomes evident in the figures and drawings that they have difficulty distinguishing between homogeneous and heterogeneous mixtures. They often confuse the two, especially if they have no experience observing both types in real life. Terms such as "heterogeneous," "insoluble," "suspension," and "colloid" are difficult to learn, especially if they are not connected to concrete examples. Heterogeneous mixtures can settle over time, leading to confusion about their classification and properties. Students may temporarily perceive a well-mixed suspension as homogeneous. If they observe these mixtures only at the macroscopic level, they may miss the differences at the particle level that define heterogeneity. For example, particles in muddy water or sand in water may not be easily seen. The concept of particles being different and not dissolving requires an understanding of molecular interactions that are abstract to most students. Without hands-on experiments, it is more difficult for students to see how insoluble substances behave in water. Students may not fully grasp why some substances dissolve in water while others do not. The concepts of polarity, hydrogen bonding, and intermolecular forces are important but require a strong foundational understanding of chemistry. They may not understand why particles of certain substances clump together or settle rather than spread evenly. Students may struggle with the idea that the polarity of water affects the ability of some substances to dissolve but not others. Understanding the hydrophilic and hydrophobic nature of substances

can be difficult. Explaining that dissolution is not just about mixing but also involves energy changes can be very abstract without the proper scaffolding.

Conclusion And Discussion

This section includes the results of the findings obtained within the scope of the research and suggestions for future research in line with these results. In this study, it was tried to determine the learning levels of the students by applying two different methods to the subjects of chemical bonds, states of matter, mixtures and atomic structure of the general chemistry course. Therefore, it was tried to determine the spatial visualization abilities of the students and their knowledge levels about the particulate structure of matter. The following conclusions were reached based on the data obtained from the tests applied before and after the study. When the SVT scores obtained in this study were examined, it was seen that the success of the student groups was 30 out of 100 points above the pretest score average and 37 in the posttest (Table 1). In addition, when the independent t test results of the data obtained in the pretest of the study groups in Table 2 were examined, it was determined that there was no statistical difference between the groups ($p>0.05$). Again, it is seen that there is no difference in the independent t test analysis of the data taken by the groups in Table 2 in the posttest ($P>0.05$). However, when the effect sizes of the pretest and posttest scores of the students in the study groups are examined, it is seen that the experimental group is making progress close to the medium level (Table 3). It is seen that the students in the experimental groups who made progress in visualization are successful in chemical bonds, states of matter, solution and atomic structure PNMT. Similar studies (Garnett & Treagust 1992; Karaçöp, 2010; Sanger & Greenbowe 1997) support our data. On the other hand, when the mean scores obtained from the spatial visualization test of the students participating in the study are compared with the scores obtained in

the studies using the same test, it is found to be consistent with the results of Bodner & Guay (1997) and Yang et al., (2003), but lower than the results of Ferguson (2008) and Keehner et al., (2008). Understanding chemical bonds continues to be a complex and often challenging topic for students. Several factors contribute to the difficulties in understanding chemical bonds, from the abstract nature of the subject to the limitations of classical models. Chemical bonds are not physical objects that can be touched or directly observed. Rather, they are conceptual constructs that describe the interactions between atoms that hold molecules together. The most basic types of bonds, covalent and ionic bonds, are based on principles of electron sharing or transfer that are invisible to the naked eye. The difficulty of visualizing and directly observing these interactions makes understanding chemical bonds inherently abstract (Doymus, 2008; Sanderson, 2012). While covalent bonds involve the sharing of electron pairs between atoms, ionic bonds result from the electrostatic attraction between positively and negatively charged ions. These interactions occur on an atomic scale, far beyond the limits of human perception. In bonding theory, electrons in bonding orbitals lower the energy of a system, while electrons in antibonding orbitals increase its energy. The resulting electron configurations determine the strength of a bond and the stability of a molecule. Understanding how electrons fill orbitals and how these orbitals interact to form bonds requires a good understanding of quantum principles, which can be an obstacle for students who do not have a solid foundation in this area (Hunter et al., 2022; Karacop & Doymus, 2013). The only reason why the experimental group students were more successful than the control group in our study may be due to peer assistance in the C2M method.

It is seen that EG and CG students could not answer the dissolution and mixing problems at the molecular scale at the expected level. The main reasons for this are; It is difficult to

visualize the behavior of molecules, especially for beginners. The idea that substances mix or dissolve at the molecular level (where interactions occur between individual particles such as atoms, ions, or molecules) can seem abstract and disconnected from everyday experience. Without a concrete way to "see" these interactions, students may have difficulty understanding how substances behave at such a small scale (Akgün, 2009). It is seen that many students who participated in the study did not fully understand why some substances dissolve in solvents while others do not. The dissolution process involves breaking down the intermolecular forces in the solute and solvent and creating new interactions between them. Students may miss the idea that the molecules in a solution are in constant motion and evenly distributed, making it difficult for them to visualize how and why a mixture forms. Many students are not yet familiar with the molecular models used to describe solutions and mixtures (e.g., homomolecular systems formed by the random motion and mixing of molecules). (the idea of a generic solution) has not been fully grasped (Kandemir & Apaydın, 2024; Vaiopoulou et al., J., 2023). In addition, it is stated in the graphs and figures given in the article that students have difficulty representing molecules in diagrams or simulations, which are usually basic tools for explaining molecular behavior. Another issue seen in the study is that students also have difficulty distinguishing between types of mixtures at the molecular level, such as homogeneous and heterogeneous mixtures. It is seen that students generally have difficulty solving problems related to molecular-level events in the state graph of the matter and do not fully understand the event. The main reasons for this are that the behavior of the matter at the molecular level is quite abstract and cannot be observed directly. Students are usually more familiar with the macroscopic properties of matter (e.g. temperature, pressure, volume), and it can be difficult to understand how these are related to molecular motion (e.g. kinetic energy, intermolecular forces and collisions). It can be difficult to visualize how molecules behave in

different states (solid, liquid, gas) and during phase transitions (Harrison & Treagust, 2002). While students may understand the concept of boiling or melting, they may have difficulty relating these processes to molecular interactions, such as the breaking and forming of bonds, changes in kinetic energy, or overcoming intermolecular forces (Adadan & Ataman, 2023). The state-of-matter graph often includes understanding energy changes, such as latent heat, during phase transitions (e.g., melting or vaporization), which are difficult for students to grasp. They may not intuitively understand how energy is distributed between potential energy (due to molecular interactions) and kinetic energy (due to molecular motion). Students may have difficulty understanding these concepts in a conceptual or mathematical framework if they have not been exposed to clear, concrete examples or hands-on experiments (such as using models, simulations, or animations) that demonstrate molecular behavior (Girón-Gambero & Franco-Mariscal, 2023; Mishra & Kumar, 2023).

The findings of this research will contribute to the growing body of knowledge about innovative teaching methodologies in chemistry education and provide practical recommendations for educators aiming to improve student engagement and learning outcomes.

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CHAPTER 6

THE EFFECT OF FAMILY PARTICIPATION IN EDUCATION ON STUDENTS' DEVELOPMENT AND TEACHERS' PERSPECTIVE ON THE FAMILY ROLE

TUĞBA İNCİMAN ÇELİK[1]

Giriş

The family is the most fundamental building block of an individual's life and is considered the most important unit of the social structure. This environment, where an individual experiences their first social experiences, shapes their value judgments, lays the foundations for identity development, and learns cultural values and behaviors, plays a critical role in the emotional and mental development of the individual. The individual acquires both their developmental needs (McWayne et al., 2004) and the adaptation skills they need to use in society within the family (Temel et al., 2010; Yıldız Taşdemir & Durmuşoğlu, 2018). In this context, the family's contribution to education emerges as a determining factor and the most effective basic institution in the processes of individuals' integration into society (Berger, 1991; Bronfenbrenner,

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1986; Kocabaş, 2006; Waander et al., 2007). Education aims to provide individuals with knowledge and skills while also equipping them with social values, therefore, the role of the family in education in this process covers a wide range from students' academic success to social skills.

The level of family participation in educational processes can have significant effects on students' motivation, academic success, and social behavior (Çeçen et al., 2024; Fan & Chen, 2001; Gottfried et al., 1994; Hill & Tyson, 2009; Özdemir, 2018). Research provides strong evidence that family participation increases students' school performance and learning motivation (Epstein, 2011; Hill & Tyson, 2009). In the school age, teacher and family collaboration in the education-training environment is important for the individual to learn new behaviors, for these behaviors to be permanent, for them to gain 21st century skills, and for them to adapt (Kang et al., 2017; Mazer & Thompson, 2017). Family participation should be supported for the individual who is desired to adapt to school, thus, students who feel the support of the institution they opened their eyes to life develop a positive attitude towards learning and school (Fan & Chen, 2001). Family participation helps students feel like they are in a home environment, contributes to their cognitive, social, emotional, language and psychomotor development (Gürşimşek, 2003; Kartal, 2007) and can increase their academic success (Knopf & Swick, 2008; Monti et al., 2014; Özdemir, 2018). The participation of families in the educational processes of their children not only increases academic success; it also contributes to the emotional and social development of students (Epstein, 2011; Özdemir, 2018). The supportive attitudes of families directly affect the performance of children at school. For example, the active participation of families in the educational process increases children's self-confidence Çamlıbel Çakmak (2010) and increases their motivation to learn (Bilgin, 2022). Supportive family attitudes

increase children's interest in learning, reinforce their self-confidence and enable them to participate more actively in the learning process. This is considered a critical factor for the overall success of the education system.

A supportive family environment increases students' academic success, while indifferent or controlling attitudes can negatively affect students' motivation (Grolnick et al., 2009). In cases where family involvement is low, teachers face various difficulties and may encounter significant obstacles in students' development processes. While a caring and supportive family environment allows students to develop their emotional intelligence and reinforce their social skills, indifferent or controlling attitudes can cause negative emotional states such as anxiety, stress and low self-esteem in students. Various difficulties can be encountered in the implementation of family and teacher collaboration. Factors such as parents' busy working hours, socio-economic situations or language barriers can limit the effective implementation of this collaboration. In addition, in some cases, families' prejudiced attitudes towards schools and teachers can make collaboration even more difficult. In order to overcome such difficulties, schools need to organize informative and supportive programs for families, diversify communication channels and encourage family involvement. In general, family-teacher collaboration constitutes an important building block that contributes to a holistic approach to the student's education process. Educators should develop various strategies to encourage and support the active participation of families in their children's learning processes. Effective communication between teachers and families contributes positively to both students' academic success (Görür, 2020; Öcal & Akpınar, 2020) and their social development. In addition to increasing student success, family-teacher collaboration also enriches teachers' professional experiences and increases the quality of the educational process

(Çamlıbel Çakmak, 2010; Jeynes, 2016; Öcal & Akpınar, 2020; Sheldon & Epstein, 2005; Yakıcı, 2018). For families, it provides advance awareness so that they can observe their children and be aware of their needs (La Paro et al., 2003; NAEYC, 2005; Temel et al., 2010).

Purpose and Importance of the Research

Education literature reveals that family involvement is a factor that increases student success and encourages positive behaviors. However, the effects of family attitudes on students have not yet been addressed in sufficient depth (Kim et al., 2020). The importance of family involvement in education is emphasized and it is emphasized that increasing this involvement can contribute to students' academic and behavioral development in a holistic way and create positive effects on their development. As a result, the interaction between family and education is of critical importance in the development of individuals and the strengthening of the social structure. Ensuring the active participation of families in educational processes is the responsibility of teachers (Ersay, 2010; Polat Yaman & Saçkes, 2017), and strengthening this cooperation will positively affect students' academic and social success. Understanding the importance of family involvement at every stage of the education system and encouraging this participation is an important step towards creating a healthier society in the future.

This study aims to examine the effects of family involvement on academic and behavioral development in detail and systematically analyzes the information in the literature. In line with the objectives of the study, it is aimed to emphasize the importance of family participation. In addition, the study aims to provide practical suggestions for educational institutions and teachers to increase family participation. It will be examined how methods such as effective communication strategies, guidance programs and social

awareness studies can play a role in strengthening family participation. The findings contribute to the development of more effective policies in the field of education and reshape the role of family participation in education.

The research questions related to the problem are given below.

1. How is family participation in the education process addressed and what is the effect of this participation on students' academic success and behavioral development?
2. What are the methods used to develop cooperation with families and the effects of these methods on classroom practices?

Method

This study was conducted using the document analysis method. Document analysis is the process of obtaining information through systematic evaluation of information obtained from existing sources and literature (Bowen, 2009). In the research, previous academic studies on the effects of family involvement were examined. The data collection process will be carried out with the following steps: (i) Literature Review: Academic studies on family involvement were scanned. (ii) Document Analysis: Findings on the effects of family involvement on student achievement and behavior were brought together from the determined sources.

Findings

The findings were collected under certain headings.

Reflections of family involvement on classroom practices and student achievement

Family involvement is an important factor in students' academic success. The support that families provide in the educational process shapes students' attitudes towards learning and makes it easier for them to achieve their academic goals (Chen, 2023; Desforges & Abouchaar, 2003; Epstein, 2011; Fan & Chen, 2001; Hattie, 2009; Henderson & Mapp, 2002; Hoover-Dempsey & Sandler, 1997; Jeynes, 2016; Marcon, 1999; Özdemir, 2018). This involvement strengthens students' ties to school and enables them to develop a positive attitude towards lessons (Fan & Chen, 2001). It also helps support permanence in learning (Görür, 2020). Supportive attitudes reinforce students' self-confidence and improve their problem-solving skills (Epstein, 2011; Gottfried et al., 1994). Studies show that active participation of families in the educational process has a positive relationship with students' grades (Bruïnea, 2014; Jeynes, 2016). Providing a regular study environment and supporting their children with learning opportunities directly increases academic success (Chen, 2023; Özdemir, 2018). When families have high but realistic expectations from their children, it increases students' motivation and performance (Görür, 2020). While excessively high expectations create stress and a sense of inadequacy, low expectations can lead to loss of self-confidence. Balanced and encouraging expectations help students both develop their potential and achieve their long-term goals. As a result, the academic support and guidance families provide to their children directly affects their success levels.

Contribution of family involvement to motivation and personal development

Parents' attitudes affect children's participation in and motivation to education. Caring and supportive families increase

children's self-confidence and ensure that they are more motivated in their education (Fan & Chen, 2001). Supportive attitudes reduce students' anxiety levels and accelerate their adaptation to school. It has been observed that students become more relaxed and more adaptable to school by getting rid of their anxiety (Decker & Decker, 2005). On the other hand, indifferent or controlling family attitudes negatively affect students' motivation and can lead to lack of self-confidence and low performance. Excessive control reduces interest in learning processes by weakening the sense of independence. It has been observed that students who grow up under controlling attitudes do not develop decision-making skills and their motivation for learning processes decreases under excessive pressure. As a result, it can be said that family attitudes play a determining role in students' academic motivation and personal development.

Teachers' perspectives on family collaboration

By establishing effective communication with families, teachers can positively affect students' in-class performance, academic success, behavioral development, and motivation. A strong family-teacher collaboration enables personalized teaching methods that take into account students' individual differences (Yakıcı, 2018). In addition, it has been observed that in classrooms where teacher-family communication is strong, discipline problems decrease and classroom interactions become more constructive (Epstein, 2011; Selanik Ay & Aydoğdu, 2016). When families receive regular information about their children's in-class performance and set common goals with teachers, it allows students to have a more determined attitude towards their education processes. When teachers take feedback from families into consideration, it increases the effectiveness of in-class practices and supports student success. In this context, family-teacher collaboration is an important element that encourages a holistic approach in education. Teachers face some difficulties in the participation of families in education. For example,

some families may be overly interfering and prevent students from developing independence, or they may not be able to participate sufficiently in education due to economic, cultural, and language barriers. Such limiting factors are among the main factors that make teacher collaboration processes difficult. In order to strengthen family collaboration, teachers use regular family meetings, meetings, and digital communication tools. These meetings play a critical role in sharing students' academic status and evaluating family feedback. Digital platforms increase collaboration by allowing teachers to communicate more flexibly and continuously with families. In addition, practices such as workshops, parent seminars, and school events increase families' awareness of educational processes and create a stronger bond between teachers and families. These methods make collaboration more efficient and contribute to students' academic and personal development.

Conclusion and Recommendations

Conclusion

Family involvement has a critical impact on students' academic and behavioral development and stands out as an important area of research in education. Literature shows that family involvement is a fundamental element that increases student success and encourages positive behaviors. Therefore, teachers, educational institutions and social actors need to work in collaboration in order to ensure more active participation of families in educational processes. In particular, it is important for teachers to establish strong communication with families and include families in the process for the success of this collaboration.

Family involvement is seen to support not only academic success but also social and emotional development. Supportive family attitudes increase students' motivation to learn and their commitment to school, while strengthening their self-efficacy

beliefs. However, it should also be noted that indifferent or overly controlling family attitudes negatively affect students' academic success by damaging their self-confidence. One of the basic conditions for creating a healthy learning environment is for families to adopt a trustworthy approach towards their children and allow them to discover their individual potential.

Teachers' interaction with families is an important factor that directly affects classroom dynamics and student success. Face-to-face meetings, parent meetings, and effective use of digital platforms are powerful tools for increasing family participation. In addition, teachers expressing their expectations from families clearly increases the efficiency of communication processes and minimizes potential problems.

As a result, family participation is an indispensable element that contributes to both student development and teachers' professional experience. Strengthening family and school cooperation should be considered as one of the fundamental building blocks of the education system. Education policies should be rearranged to encourage family participation, thus providing a learning environment that will maximize students' potential. It has been concluded that policies and practices that encourage family participation should be developed with a holistic perspective in order to achieve more effective results in the field of education.

Recommendations

In light of the findings, the following recommendations have been developed to increase family participation and make positive contributions to students' development processes within the scope of developing family-teacher collaboration in education:

Strategies for educational institutions: Educational institutions can organize regular information meetings, seminars, open-door days and workshops to encourage family participation.

An effective communication network should be established between the school and the family by creating a culture that allows families to participate in school decision-making mechanisms. Such events help families establish stronger communication with the school and teachers and gain awareness about the education process. In addition, a school culture that takes into account families' opinions and suggestions should be created in order to increase family participation. The participation of families in school decision-making mechanisms and sharing their thoughts about the education process will increase their commitment to the school and ensure that the collaboration is carried out more efficiently.

Organizing one-on-one meetings and interviews: Teachers should provide regular feedback on student achievements and development to encourage family participation. This feedback informs families about the student's academic status, social development and behaviors, allowing families to take a more active role in the education process. In addition, it is important for teachers to establish open and trusting communication with families. Developing a positive and constructive dialogue with parents strengthens the relationship between families and the school and increases cooperation.

In order for family-teacher meetings and one-on-one interviews to be effective, these meetings must be planned and organized. Teachers should prepare for these meetings in advance and focus on specific issues and development areas related to the student. During the meetings, families should also be encouraged to actively participate in the process and their opinions should be taken into account. Families sharing their feedback on the student's education process and determining common goals with teachers will ensure that the meetings are more productive.

In this context, teachers' regular one-on-one meetings with families allow them to follow the student's development process

more closely. In one-on-one meetings, teachers can share detailed information with families about the student's strengths and weaknesses and develop appropriate strategies for the student. In addition, these meetings provide a suitable platform for families to ask their questions about their children's education and make more informed decisions about the education process. In addition, during these meetings, families and teachers can make a joint plan in line with the student's individual goals and needs. Such collaborative approaches allow for the determination of more comprehensive and effective strategies for student development.

Use of digital communication tools: Digital communication tools are an effective way to improve family-teacher collaboration and make the communication process more flexible. Teachers can communicate with families regularly using digital tools such as e-mail, online meetings, and instant messaging applications. Such digital platforms allow teachers to share information with families about the student's academic status and families to provide feedback to teachers. In addition, families can participate in the educational process independently of time and place thanks to digital tools. This makes it easier for families to be more involved in the educational process and to work in collaboration with teachers.

Organizing social and cultural events that support family participation: In order to encourage family participation, schools can organize various social and cultural events. School events allow families to establish a stronger bond with the school and strengthen their collaboration with teachers. Families taking an active role in school activities and working with teachers in this process contribute to the creation of a supportive learning environment for students.

Guidance and support programs: Guidance and support programs should be organized to support families' participation in the educational process and ensure that they take on a conscious role. These types of programs provide families with the opportunity to

learn about the educational process and provide support for their children's academic and social development. Through guidance and support programs, families learn about their children's learning processes, behavioral development, and school life. At the same time, these programs are important for families to ask questions about education and receive guidance appropriate to their children's needs.

As part of guidance programs, parents can be informed about issues such as child development, learning styles, effective communication, and positive discipline. Such trainings allow families to develop a more conscious and supportive approach to their children. In addition, seminars and workshops can be organized for families to encourage parents' active participation in the educational process. In these seminars, topics such as working methods that will support children's academic success, how to create a learning environment at home, and effective communication techniques with children can be discussed. In this way, families are provided with the knowledge and skills that will contribute to their children's educational processes.

As part of support programs, families can be provided with guidance on coping with the problems they encounter at school and the difficulties they experience during their educational processes. For example, support programs can be organized for families of students with special educational needs and guidance can be provided to these families on how to be involved in their children's learning processes. Such supportive programs help families to participate more consciously in their children's educational processes.

Teacher education programs: Special emphasis should be placed on family communication skills in teacher education programs. Teachers should gain effective communication and collaboration skills with families, and thus encourage family

participation. Family participation strategies can be included in teachers' professional development programs to increase teachers' knowledge and skills in this regard. Family communication skills training should be added to professional development programs so that teachers can establish and maintain effective communication with families. Learning how to communicate with families and gaining skills in this regard by prospective teachers during their education processes plays an important role in ensuring cooperation. In this regard, teacher education programs should include courses and workshops to develop skills such as effective communication with families, conflict resolution, empathic listening and feedback.

Research and evaluation: In order to better understand the effects of family participation, continuous research should be conducted and the relationship between family participation and student success should be examined within a broader framework. Education policies and practices should be evaluated by collecting data on family participation and student success.

Social awareness: Raising awareness in the society about the importance of family participation can enable families to participate more actively in educational processes. Media campaigns and community events can be used to emphasize the importance of family involvement. These recommendations provide an important roadmap for encouraging family involvement at every stage of the education system and making positive contributions to students' academic and behavioral development. Strengthening family-school partnerships in education is critical to increasing students' future success.

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CHAPTER 7

MAXIMIZING ENGLISH LANGUAGE ACQUISITION: THE INTEGRATION OF TEACHERS' ROLES, DIGITAL PLATFORMS AND TECHNOLOGY-ENHANCED LEARNING TOOLS

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Introduction

In the contemporary world, technology significantly influences nearly every dimension of life. Raja and Nagasubramani (2018:33) emphasize that the modern era is often referred to as the technological age. Continuous technological advancements and emerging trends bring transformative changes across various fields. Furthermore, Aziz et al. (2018:239) argue that, given the prominence of technology in today's society, educators and learners are encouraged to utilize technological resources to enhance their practices actively.

Among these aspects, education is one of the disciplines that has been radically altered thanks to technology. Technology has undergone a swift transformation, influencing daily life and educational practices (Goksu & Cavus, 2019:6134).

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With the emergence of new technological trends, there have been ground-breaking innovations in education. Goksu and Cavus (2019:6134) likewise state that these technological developments have also deeply influenced the methods used in teaching English.

In parallel with the aforementioned technological era, instructional methods in language learning have developed significantly. Zainuddin (2023:69) indicates that the rapid advancement of technology in recent years has shown strong potential as a tool for enhancing language education. Therefore, language learning is now feasible through various new technological trends. Additionally, Garrett (1991:95) expresses that the potential for technology to significantly improve foreign language instruction is evident.

The implementation of new technological trends brings numerous advantages to language learning by enhancing accessibility, personalizing learning experiences, promoting learner autonomy, increasing engagement, and offering instant feedback through innovative digital platforms and tools.According to Zainuddin (2023:69), individuals can successfully learn an entirely new language with the assistance of technological innovations. In addition to acquiring a foreign language from the ground up, learners can also feel more motivated when using new technological trends in their language learning processes. As stated by Aziz et al. (2018:236), by utilizing technology, students are more encouraged to study English. Similarly, Zainuddin (2023:70) affirms that learners' enthusiasm and drive increase when technology-based activities resemble real-life scenarios. Besides motivation, technology also enhances learners' interest in language learning. For instance, Raja and Nagasubramani (2018:33) assert that technological devices such as projectors can boost learners' engagement and curiosity during lessons while contributing to increased motivation.

Unlike other academic subjects, language learning can take place through real-life exposure. In this regard, Aziz et al. (2018:239) suggest that an individual can learn a language independently of formal

lesson periods. Therefore, limiting language learning only to the classroom environment may not be practical and could negatively affect learners' success. In such cases, the application of new technological trends in language learning is advisable.

Even though technology constitutes a substantial part of everyday life, the implementation of new technological trends in education is still not widespread. According to Golonka et al. (2014:70), in many advanced countries, conventional tools such as laptops and internet access have become essential for learning a foreign language.

According to Garrett (1991:95), technology may have a significant influence on how individuals learn languages and on how this influence is studied. Thus, the implementation of new technological trends would be beneficial for the advancement of research in this area. However, although these trends are widely used in today's world, there are still not enough studies that explore their relation to language learning. As one of the few current studies on technology and language learning, Zainuddin (2023:77) suggests that despite the immense progress and potential of technology, findings indicate that the analysis of technology-enhanced language learning (TELL) remains in the early stages of development.

Literature Review

The current literature focuses on five major points to examine the effects of new technological trends on language learning: The Teacher's Role in Integrating Technology into Language Education, Enhancing Language Learning Through Mobile Apps and Game-Based Activities, Flipped Classroom in Technology-Enhanced Language Learning, General Artificial Intelligence (GAI) models such as DeepSeek AI and ChatGPT.

The Teacher's Role in Integrating Technology into Language Education

In the process of language learning, teachers play a crucial role in ensuring that learners receive a comprehensive and effective education. Language teachers employ a variety of instructional techniques, and with the advancement of technology, these techniques have evolved considerably in recent years. Technology offers both advantages and disadvantages in the context of language teaching. When used appropriately, technological developments can enhance the effectiveness of language instruction. However, Garrett (1991:95) emphasises that the integration of technology into language education is only possible if teachers and learners express their needs regarding technological tools and reflect on how these tools can be used effectively. In other words, the successful incorporation of technology into language learning depends largely on the guidance and leadership of teachers. To fulfil this leadership role effectively, teachers must have a solid command of technological tools and be capable of managing the learning process efficiently. Similarly, Levy (2009:777) highlights that it is the responsibility of teachers to remain informed about technological advancements to ensure appropriate use in language teaching. One of the first steps in implementing new technological trends is for teachers to develop awareness of current developments. With appropriate training and knowledge, teachers are better equipped to guide the integration process effectively.

To successfully incorporate new technological trends into language learning, teachers need to receive adequate professional training. In this regard, Carr et al. (2011:19) argue that educational institutions must invest time and effort in training educators and instructors if they aim to implement technology-blended language learning in a more effective and student-centred way. The integration of technology into language teaching becomes significantly easier

when instructors are equipped with the necessary training. Furthermore, trained teachers can make more informed decisions about which technological tools to utilize in specific instructional contexts.

Moreover, teachers should prioritize the integration of authentic and realistic materials when introducing students to emerging technological tools, as language learning is most effective when it occurs in meaningful, real-life contexts. In line with this, Zainuddin (2023:70) highlights that incorporating natural materials through learning technologies makes language instruction more engaging and relevant. By presenting learners with realistic examples of language in use, teachers help students develop a clearer understanding of how language operates in authentic situations. Zainuddin (2023:70) further argues that technological innovations can simulate lifelike learning environments, thereby enhancing the overall effectiveness of language instruction.

Among these technological resources, **the Internet** stands out as one of the most powerful tools available to language educators. It not only offers immediate access to a vast range of educational materials but also facilitates communication, which is a key component of successful language acquisition. Supporting this view, Yang and Chen (2007:861) argue that the Internet allows learners, particularly those studying English as a foreign language, to engage with authentic language sources and communicate directly with native speakers. Such interactions provide learners with valuable opportunities to practice the target language in realistic contexts, making the learning process more meaningful and practical.

Additionally, Gangaiamaran and Pasupathi (2017:11242) note that technological tools enabling Internet access have expanded the possibilities for global communication, allowing learners to interact with people worldwide. This increased connectivity plays a

crucial role in exposing students to authentic language environments. As Yang and Chen (2007:861) further emphasize, engaging with real-life language use through the Internet not only provides learners with practical application opportunities but also reduces their dependence on artificial or contextually irrelevant language input. Therefore, integrating Internet-based resources and communication opportunities into language instruction is essential for fostering meaningful, authentic language learning experiences.

Durán and Cruz (2011:228) highlight that the true impact on teaching and learning depends not only on the tools available but on how teachers apply them in practice. This makes teacher preparation and effective use of such tools essential. Our research revealed that when teachers integrated **the Interactive Whiteboard (IWB)** into their lessons, students showed greater enthusiasm and participation, as reflected in teacher feedback. To build on this success, teachers are encouraged to take the initiative in developing an online repository of IWB activities. Currently, a wide range of resources, particularly in English for young learners, is already accessible. Among these, story-based materials hold special value, offering teachers additional support in promoting language learning through engaging content.

Imamguluyev et al. (2024) underline that Artificial intelligence serves not as a substitute for educators but as a supportive tool that strengthens their teaching and mentoring capacities. Teachers remain essential in guiding learners, promoting critical thinking, and safeguarding ethical practices within AI-assisted educational environments. Through the effective use of AI, educators can gain deeper insights into student needs, monitor their development, and provide tailored support

In conclusion, the use of technology by teachers is fundamental to the success of language instruction. Among the most significant trends in language learning are the Internet and the

Interactive Whiteboard. The Internet promotes language acquisition by providing accessible and authentic learning environments, while IWBs enable the implementation of dynamic and varied classroom activities. Furthermore, Yang and Chen (2007:877) suggest that effective use of new technological trends in language education begins with teachers who are knowledgeable and confident in using computing infrastructure, and who are supportive of integrating these tools into the curriculum. Ultimately, in the context of language learning through technology, the teacher's role is of paramount importance.

Enhancing Language Learning Through Mobile Apps and Game-Based Activities

Today, language learning has become more accessible than ever thanks to mobile apps and AI-powered tools. These platforms offer flexible, personalized learning experiences tailored to meet different learner needs. Among the most popular and highly rated apps are MakesYouFluent, Duolingo, Babbel, Talkpal, Rosetta Stone, Univerbal, Tutor Lily, Memrise, LingoDeer, HelloTalk, Busuu, Speak, Tandem, Lingvist, ChatGPT, Mondly, Eggbun Education, Pimsleur, Drops, and Loora.

Anderson (2025:1) underlines the instant feedback and unlimited practice with an AI tutor available 24/7, while Duolingo has a positive effect on students' performance on vocabulary learning as an educational tool (Ajisoko, 2020:154). Babbel stands out with its structured lessons designed for real-world use, making it ideal for learners with some prior knowledge. Talkpal offers realistic practice scenarios using AI technology, giving learners a personalized experience based on their progress.

Anderson (2025:1) states that Rosetta Stone is known for its immersive approach, allowing users to learn through real-life simulations. Univerbal focuses on conversational practice through

AI-generated dialogues, while Tutor Lily provides real-time corrections and pronunciation support. Memrise uses a spaced repetition system to build vocabulary, and LingoDeer offers detailed grammar explanations, especially for Asian languages.

Anderson (2025:1) highlights that Apps like HelloTalk and Tandem help users connect with native speakers worldwide for real conversational practice. Busuu follows the CEFR framework, providing a step-by-step learning path from beginner to advanced levels. Speak helps users improve their speaking and pronunciation skills through AI interaction.

Lingvist as a website, focuses on vocabulary building with adaptive learning technology, while ChatGPT allows users to practice real-life conversations on a wide range of topics. (https://lingvist.com/) Eggbun Education specializes in Asian languages, combining cultural insights with language practice. In addition, Mondly offers daily interactive lessons, combining speech recognition and gamification (Anderson, 2025:1).

Anderson (2025:1) suggests that Pimsleur emphasizes listening and speaking skills through audio-based lessons designed for learning on the go. Drops offers quick, game-based vocabulary practice in over 50 languages, and Loora provides AI-powered personal tutoring with instant feedback to support continuous improvement.

While each app has its strengths and limitations-such as the need for subscriptions, limited free content, or a focus on specific skills-they all contribute to making language learning more engaging, accessible, and personalized. Learners can choose the one that best fits their learning style, goals, and preferences to make the most of their language learning journey. (Anderson, 2025:1)

As technology advances, the use of mobile phones, laptops, tablets, and other electronic devices in daily life has become

inevitable. Kukulska-Hulme (2009:157) suggests that learning, transformed through technological support, has progressed with the widespread use of mobile phones and other portable electronic devices. Among these tools, the mobile phone is now owned by almost every individual. Aziz et al. (2018:239) note that mobile tools have become the most widely used due to their increasing usage rates. This widespread usage is largely attributed to mobile phones' portability and easy Internet access. However, other electronic devices also continue to be widely used. Generally, these devices host a variety of applications and games designed for different purposes. In addition to browsing the Internet, reading news, or engaging in social media, these devices increasingly offer platforms for educational applications and games, with more continuing to be developed.

In the current era where education and technology intersect, digital tools provide a wide range of materials for learning. Applications and games, accessible through mobile devices, exemplify these educational materials. Kukulska-Hulme (2009:160) emphasizes that mobile and wireless technologies have expanded learning opportunities beyond classroom boundaries, allowing learning to occur in more authentic, real-life contexts. While these tools support out-of-class learning, they can also be used effectively in classroom environments. Guaqueta and Castro-Garces (2018:63) explain that games requiring Internet access, a projector, and a monitor allow students to visualize actions and practice language in interactive settings. Thus, language learning through apps and games is possible in and out of the classroom, depending on the availability of suitable resources.

Integrating technological devices into face-to-face classrooms has become an additional responsibility for language teachers, who must create and support technology-enhanced learning environments (Zainuddin, 2023:69). As classroom managers and

facilitators, teachers play a key role in encouraging learners to use such technological resources. The frequency and nature of app and game use—whether occasional or continuous—are often determined by the teacher's preferences and instructional goals.

Games, in particular, enable learners to practice and develop the four main language skills: speaking, listening, reading, and writing. Chun et al. (2016:72) point out that mobile devices offer access to a range of game types, including single-player games such as word puzzles, and multiplayer virtual games such as role-playing or sports simulations. These games are available online and can be used independently or collaboratively. Even in offline mode, many games still allow learners to continue practising. Zou et al. (2018:429) argue that the primary aim of such games is to improve learning and increase learners' motivation, making them increasingly prevalent in language education.

Moreover, learners often choose games that align with the specific language skills or topics they wish to improve. When students select games based on personal interests, these games become more engaging and motivating. Games that feature detailed narratives and cooperative tasks allow learners to create personalized avatars, engage in shared missions, and apply social norms using the target language (Chun et al., 2016:66). In these contexts, learners fulfil communicative functions while immersed in both single-player and multiplayer gameplay environments.

Technologically advanced mobile devices support a diverse range of applications. These apps include social networking platforms such as Twitter, Instagram, and Facebook that facilitate interpersonal communication, as well as tools that enable access to games, videos, TV shows, and language-learning resources. According to Gangaiamaran and Pasupathi (2017:11242), the growth of mobile applications in the field of Applied Linguistics is closely tied to the expansion of mobile device usage. Language

learning is possible not only through dedicated language-learning apps but also through applications that include linguistic interaction as a secondary feature.

In conclusion, technological developments have led to the creation of applications and games specifically designed for language learning. These tools help learners acquire and enhance their language skills in a stimulating and effective way. Game selection can be tailored according to learners' age, interests, and availability of time, providing flexibility and personalization. Moreover, the use of VR and AR technologies offers learners the opportunity to engage in realistic language practice using various devices such as mobile phones. As Goksu and Cavus (2019:6134) observe, information becomes more accessible, learning becomes more enjoyable, and content is better managed and retained. Applications and games increase motivation and make the language learning process more engaging. Whether used under teacher guidance or independently, these digital tools provide learners with enriched and enjoyable learning experiences.

Flipped Classroom in Technology-Enhanced Language Learning

New technological trends that contribute to language learning are not limited to physical devices or software innovations. In addition to previously mentioned tools, the flipped classroom approach is widely regarded as a significant trend in technology-enhanced language learning. According to Tucker (2012:82), although various models of flipped learning exist, the fundamental principle involves reversing the traditional instructional method by providing students with instructional videos created by the teacher, which learners can access from home before attending class. In this way, learners are introduced to course content before the lesson begins.

Bishop and Verleger (2013:23.1200.5) categorize flipped learning into two key components: individual instruction at home through video-based learning and collaborative learning tasks conducted during class sessions. This approach allows more class time to be allocated to interactive tasks and activities, as the foundational material is learned beforehand. In line with this, Vitta and Al-Hoorie (2020:17) state that flipped learning is more structured than traditional instruction, as it enables students to prepare in advance and then consolidate their understanding during class. Supporting this view, in her review study, Hava (2024:175) points out that the findings indicate that the key benefit of flipped learning is its ability to improve students' writing, speaking, and overall academic success.

Flipped learning can be applied to a wide range of subjects, including language education. In fact, it is considered one of the most widely implemented educational technologies. Regarding its application in language learning, Zou et al. (2018:438) emphasize that flipped learning is particularly prominent in technology-assisted language learning, given its reliance on digital tools. Evseeva and Solozhenko (2015:209) underscore its significance by stating that "... the flipped classroom is a promising technology which should not be underestimated."

When compared with traditional educational models, the flipped classroom approach offers numerous advantages for learners. Evseeva and Solozhenko (2015:209) assert that flipped learning increases students' enthusiasm and engagement in foreign language education. The study conducted by Evseeva & Solozhenko (2015:208) revealed that 85% of learners favoured the implementation of flipped learning, although some participants expressed concerns due to difficulties encountered with the technology.

As with many educational technologies, the success of the flipped classroom model is closely linked to the instructor. Basal (2015:34) argues that teachers must be well-versed in the underlying principles of the flipped model for it to be effectively applied. Basal (2015:29) also notes that the increasing availability of Internet access has facilitated the dissemination of video content for language instruction.

The advantage of the flipped classroom is the enhancement of learners' language skills, particularly speaking. Features such as online discussions, message boards, and real-time conversations—often included in flipped learning environments—create opportunities for communicative practice (Evseeva & Solozhenko, 2015:208). Moreover, flipped learning not only allows for greater in-class interaction but also optimizes time for students and instructors.

In parallel with numerous studies, Vitta & Al-Hoorie (2020:17) flipped learning is a highly effective and adaptable model in contemporary language education. It provides significant benefits for both educators and learners and offers distinct advantages over traditional instructional approaches. For these reasons, it should be seriously considered as a central strategy by language instructors

Flipped learning allows students to access instructional content before class—typically via videos—and to use in-class time for more interactive and practical activities. As such, flipped learning extends the learning process beyond the traditional classroom setting and supports more organized and efficient language acquisition (Aziz et al., 2018:236).

In addition to flipped learning, games and applications play a prominent role in modern language education by motivating and engaging learners. For instance, Aziz et al. (2018:236) highlight that language learning applications may include features such as tests, interactive chat opportunities with real teachers, vocabulary training,

and translation tools. These applications support the development of all four language skills: speaking, reading, writing, and listening. Similarly, online games have been shown to facilitate language learning by providing immersive and interactive environments (Mohammadi et al., 2011:466). These digital tools can be integrated into classroom instruction or used independently by learners to reinforce their language proficiency.

General Artificial Intelligence (GAI) models such as DeepSeek AI and ChatGPT

Aydın (2024:24/25) summarizes the pros and cons of using ChatGpt in his study as follows: In today's digital era, conducting such research without the aid of technological tools is nearly impossible. Among these tools, ChatGPT stands out as a valuable resource due to its adaptability, intelligence, and potential for collaborative use throughout the research process. However, despite its benefits, ChatGPT is not free from drawbacks. It may misinterpret context, generate inaccurate or misleading information, and even produce entirely fabricated content. These risks raise concerns about the reliability and validity of its outputs. Nonetheless, the integration of AI tools like ChatGPT in research is becoming unavoidable.

Söderström et al. (2024:9) echo these concerns while also acknowledging the benefits of generative AI. They argue that such tools have the potential to influence students' learning outcomes positively. Nevertheless, they emphasize the necessity of implementing safeguards and guidelines to ensure responsible and equitable use. They further highlight the importance of earning educators' trust in the fairness and effectiveness of AI-based technologies.

Wang & Fan (2025:17) display benefits of using ChatGPT in the process of learning. However, they underline the importance of teacher factor in this period. They state that it works best when

teachers use it together with learning methods like Bloom's Taxonomy. This helps students think more deeply, since ChatGPT cannot really be creative or think critically on its own. ChatGPT can be used with students of all ages, from middle school to university. In middle school, it can make lessons more interesting and help students understand difficult ideas. At the university level, it can give students personal suggestions to improve their learning. It can also be used in many different subjects, like science, language learning, writing, and problem-solving. For example, it can help students come up with different ideas, practice problem-based learning, or improve their writing and grammar. ChatGPT works best when students use it regularly for four to eight weeks. If students use it for a shorter time, teachers should give them extra support, like showing them how to ask better questions to ChatGPT. Still, there are some limits. ChatGPT cannot really think or create new ideas by itself. It needs teachers to guide students on how to use it well. If teachers do not give this support, students might not learn as much. So, while ChatGPT can help students a lot, it is important that teachers plan carefully and support students as they use it.

Cui (2025:1-2) draws attention to the ease brought by technology and sheds light on to what extend the swift development of General Artificial Intelligence (GAI) has had a profound impact on multiple fields, particularly academic research. Unlike narrow AI, which is limited to performing specialized tasks, GAI is capable of handling a wide range of cognitive activities, such as reasoning, problem-solving, and understanding context. In recent years, the integration of GAI into higher education has reshaped how students approach scientific exploration, literary studies, and technological advancements. AI-driven tools like DeepSeek AI and ChatGPT provide advanced features such as natural language processing, information analysis, and automated problem-solving, making them essential resources for academic work. These technologies help

students quickly process large datasets, produce valuable insights, and improve the accuracy of their research methods. Moreover, GAI's ability to foster critical thinking and support interdisciplinary projects has led to a shift in how research is conducted. As universities worldwide continue to adopt GAI technologies, their use brings new possibilities and important challenges. These include ethical considerations, questions about intellectual property rights, and the need to safeguard academic honesty in AI-assisted research. While the benefits of improving productivity and increasing knowledge accessibility are evident, it remains important to closely examine how GAI influences students' research abilities and their potential for innovation.

In addition to the conveniences mentioned above, Cui (2025:2) claims that the integration of AI-assisted research tools has also profoundly transformed the academic environment for university students, presenting unparalleled opportunities specially in advance learning, creativity, and research productivity. AI-powered platforms facilitate the management of complex research processes, including literature review, data interpretation, and hypothesis formulation, thereby alleviating the cognitive demands typically associated with conventional research practices. Tools such as DeepSeek AI and ChatGPT offer advanced capabilities that enable students to produce detailed summaries, identify emerging trends within scholarly literature, and engage in sophisticated critical analysis. Moreover, these technologies support personalized learning by tailoring their outputs to the specific needs of individual researchers and providing context-sensitive recommendations, thus fostering a more dynamic and interactive engagement with knowledge. Furthermore, AI's capacity to process content in multiple languages promotes cross-cultural academic collaboration, granting students access to a wider range of research resources beyond linguistic and geographic limitations.

Technology-Supported Self-Directed Language Learning: The Role of Audio-visual Media

Beyond institutional settings, learners increasingly engage in self-directed learning supported by digital tools. One of the most significant outcomes of technological advancements in language learning is the increased ability of learners to engage in self-directed learning. Haidari et al. (2019:230) define self-directed learning as a process in which learners manage and direct their own learning independently. Learners may need to engage in autonomous learning in various circumstances—such as when classroom instruction is inadequate or when additional practice is needed beyond the formal curriculum. Yang and Chen (2007:861) note that issues such as limited interaction opportunities among students or overcrowded classrooms often hinder effective language instruction. In such situations, the importance of independent language learning supported by technology becomes undeniable. Given that classroom time is often insufficient for language mastery, recognizing and utilizing technological opportunities outside of the classroom becomes essential (Sert & Boynuegri, 2017:24). Therefore, students must become aware of the technological trends available to them for independent use, particularly when classroom learning is limited.

One of the most effective self-directed methods supported by technology is watching TV series, movies, and videos. These audio-visual resources offer numerous advantages, including vocabulary development, pronunciation improvement, and overall language enhancement. Their availability across various proficiency levels enables learners to select content that aligns with their current language competence. According to Haidari et al. (2019:238), watching TV programs and movies is one of the most frequently used methods by self-learners to improve their foreign language skills.

Similarly, the accessibility of online videos makes them a widely favoured tool for self-directed learning. Platforms such as **YouTube** and **Vimeo** host content in multiple languages, including different dialects and speech patterns (Chun et al., 2016:73). These platforms provide learners with the opportunity to access an extensive variety of language input on nearly any topic. Many of these videos are accompanied by subtitles, allowing learners to simultaneously engage with spoken and written forms of the language. Haidari et al. (2019:238) confirm that learners benefit from watching videos with subtitles, as this enhances comprehension and reinforces learning. In general, TV shows, movies, and videos serve as valuable supplements to classroom instruction and enable learners to extend their language exposure in enjoyable and engaging ways.

In addition to audio-visual materials, **listening to music** is another popular and effective strategy for language acquisition through self-directed learning. Haidari et al. (2019:238) identify listening to music as a commonly practiced self-learning activity, alongside video consumption. Music is often listened to in solitary settings, making it ideal for individual learning. Through music, learners are exposed to natural pronunciation, rhythm, and vocabulary. Xodabande (2018:25) reports that among Iranian EFL learners, female participants particularly preferred listening to music as part of their self-directed learning routines. Thus, music serves as an enjoyable activity and a powerful linguistic tool that supports pronunciation and vocabulary development.

Another technological resource that facilitates self-directed language learning is the **online dictionary**. Learners frequently encounter unfamiliar vocabulary during reading, listening, speaking, or writing tasks. Unlike traditional print dictionaries, online dictionaries offer immediate, efficient access to word meanings and usages. Godwin-Jones (2011:6) highlights the positive impact of

online dictionaries on learner outcomes, noting their effectiveness in supporting vocabulary acquisition. Furthermore, Haidari et al. (2019:240) report that learners perceive online dictionaries—particularly mobile-based ones—as highly beneficial for foreign language skill development. The findings demonstrate that the use of online dictionaries contributes meaningfully to all four language skills. Leffa, as cited in Golonka et al. (2014:79), notes that learners who use electronic dictionaries demonstrate higher comprehension rates compared to those who rely on traditional dictionaries. Additionally, lower-proficiency learners are able to narrow the gap between themselves and more advanced learners through the use of such tools. In today's technology-driven environment, online dictionaries have become an indispensable part of effective and independent language learning.

Beyond the practical tools discussed above, technology also fosters a significant psychological impact on learners by enhancing self-confidence and promoting learner autonomy. Godwin-Jones (2011:4) argues that when learners are given the opportunity for independent study, they gain confidence in their ability to manage their own learning, which in turn encourages cognitive and emotional growth. This realization reinforces the importance of autonomy in language learning. Similarly, Haidari et al. (2019:242) emphasize that learners who engage in self-directed activities develop greater self-assurance and the ability to manage their learning process for long-term language acquisition. Therefore, technological trends support not only language development but also learner independence and confidence.

One other effective self-directed learning activity enabled by technology is the use of **blogs**. Godwin-Jones (2011:4) notes that reading blog content or writing blog posts offers learners the opportunity to engage with authentic language in written form. Blogs can cover a wide range of topics, making them particularly engaging

for learners interested in specific areas. While blogs may not be suitable for absolute beginners, learners who have gained some familiarity with the language through videos, music, and other media can transition into reading and writing blog content. Godwin-Jones (2011:4) also underlines that individual blogs, online texts, and digital diaries can serve as powerful tools for language development. These forms of expression are particularly useful for improving two of the four core language skills: reading and writing. Learners may begin by reading blogs and later transition into blogging themselves as their language proficiency increases.

Self-directed language learning supported by technological trends is an increasingly relevant and effective approach in modern education. As Sert & Boynuegri (2017:26) emphasize, technology has made it possible for learners to study independently outside the classroom environment. Tools such as TV programs, movies, videos, online dictionaries, music, and blogs not only facilitate language acquisition but also promote autonomy and confidence. With the prevalence of these resources, learners are now better equipped than ever to manage their own language development independently and effectively.

Kannan & Munday (2018:24) claimed that one of the most prominent applications of AI in language learning is through **adaptive learning tools** adding that platforms such as Duolingo stand out for their ability to personalize content based on each learner's level and pace. By doing so, they create a more efficient and engaging learning experience, helping students progress according to their individual needs

AI also plays a crucial role in breaking down language barriers through **translation tools** like Google Translator, DeepL, Microsoft Translator, and Web Trance. These platforms provide instant translations, making it easier for learners to comprehend and engage with new texts and vocabulary (Pokrivcakova, 2019:140).

Voice assistants like Amazon Alexa, Siri, Google Assistant, and Cortana also contribute to language learning by allowing learners to practice their listening and speaking skills using voice commands. This interactive approach makes practicing a foreign language more accessible and engaging, especially when it comes to improving comprehension and pronunciation (Underwood, 2017:1).

Speaking of pronunciation, specialized **pronunciation improvement tools** such as ELSA, Orai, and Glossika provide real-time analysis and feedback on how learners pronounce words and sentences. These tools help users develop more accurate pronunciation, which is essential for effective communication (Ghafar et al., 2023:24).

Assessment is another area where AI tools make a significant impact. **Assessment and evaluation platforms** such as Fobizz, Quizgecko, and Conker allow teachers to easily create quizzes and tests, enabling them to track student progress more effectively (Mogunova, 2023:170).

In addition to aforementioned tools, Kyrpa et al. (2024:170) highlighted the unlimited opportunity the following tools with AI provide and categorised these tools like Curipod and Gamma for generating visual content, for example, interactive presentations for lessons, Twee, Conker, DeepAI, MagicSchool for creating text materials and tasks for them, including multiple choice questions, short answer questions, and open-ended prompts to the generated text and Eduaide, Hilink, MagicSchool for lesson planning.

Today, students or autonomous language learners improve their writing skills by means of diverse proofreading and feedback providing tools. Some examples of these tools include Grammarly, Ginger Writer, PaperRater, After the Deadline, Online Grammar Checker, Beewriter, WhiteSmoke, Online Correction, Hemingway, Language Tool, ProWritingAid, EssayBot, QuillBot,

GrammarCheck, Reverso, GradeProof Slick Write etc. (Fitria, 2025:2)

Finally, comprehensive **online language learning platforms** such as MyEnglishLab offer structured language courses that integrate various skills and provide both learners and teachers with tools to monitor progress. These platforms combine text, audio, and video activities to create an immersive learning experience that supports both independent study and classroom instruction (Delgado et al., 2020:14).

Methodology

In order to identify relevant articles addressing the effects of new technological trends in language learning, a comprehensive search was conducted using Google Scholar and Academia.edu. A total of 60 articles were initially retrieved on the topic; however, only 39 of these were selected for inclusion in the current paper. In addition to these 36 primary sources, the reference lists of the selected articles were also examined to further explore the relationship between new technological trends and language learning. As a result of this secondary analysis, seven additional sources were found to be substantially related to the main topic and 43 studies were used to compose the current study.

The selection process for these articles was guided by specific criteria, including the reliability of the authors and the number of citations each publication had received. The chosen articles were carefully analyzed and read multiple times to extract relevant insights regarding the impact of new technological trends on language education.

To structure the analysis, the highlighted points were organized into four subheadings, allowing the topic to be addressed from multiple perspectives. Following this, a detailed outline of the

research paper was developed to systematically present the main arguments and supporting evidence.

Discussion and Conclusion

Taking everything into consideration, technological advancements have significantly altered and enhanced various aspects of individuals' daily lives. These developments have also given rise to new trends in education, particularly in the domain of language learning. As Hubbard (2013:163) notes, the complexity and scope of language education—along with the use of technology as a learning medium—have increased considerably in recent years. In an era where technology permeates every facet of life, the field of language learning inevitably becomes increasingly dependent on technological tools, a reality that applies to learners and instructors.

Tabasi et al. (2024:21596) noted that the successful integration of these tools into teaching inevitably depends on the role of educators. Teachers must not only be skilled in using these technologies but also know how to combine them with conventional teaching methods to provide a well-rounded learning experience. The benefits of technology in language education are maximized when educators adopt and utilize such innovations appropriately and effectively.

In conclusion, new technological trends significantly impact language learning across several dimensions, including the role of the teacher, the promotion of self-directed learning, the implementation of flipped classrooms, and the use of games and applications. These developments highlight the growing need to explore and support the integration of technology into language education in a structured and research-informed manner.

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