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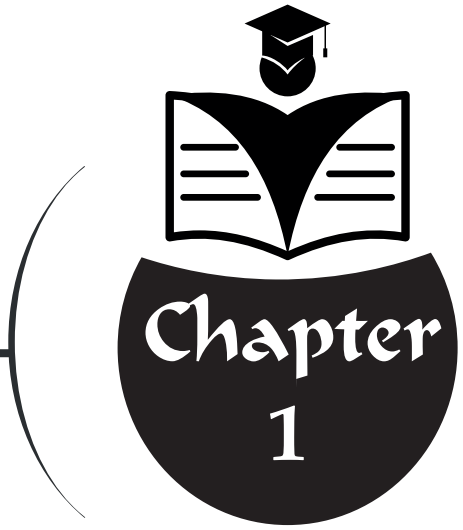

ENTREPRENEURSHIP AND BUSINESS MODEL INNOVATION: A SYSTEMATIC REVIEW OF CONTEMPORARY RESEARCH TRENDS AND THEORETICAL FRAMEWORKS

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1. Introduction

Entrepreneurship remains a cornerstone of economic development, organizational renewal, and innovation diffusion across diverse socioeconomic contexts (Smith, 2023; Johnson & Williams, 2022). The capacity of entrepreneurs to identify market opportunities, mobilize resources, and execute novel business concepts constitutes a fundamental mechanism through which competitive advantage is established and sustained. Significantly, the contemporary entrepreneurial landscape has been substantially shaped by technological advancement, globalization, and the emergence of digital business models, phenomena which collectively have rendered traditional conceptualizations of entrepreneurship increasingly inadequate for explaining modern entrepreneurial phenomena.

Business model innovation represents a central mechanism through which entrepreneurial ventures create value and achieve competitive differentiation. Importantly, it extends beyond mere technological change, involving systematic modifications to how value is created, delivered, and captured (Zott & Amit, 2010; Chesbrough, 2007). Despite its acknowledged importance, scholars vary considerably in how they define and study this concept, reflecting both the theoretical richness of business model innovation and the lack of a unified methodological framework for its systematic examination.

Building on this context, this systematic review was undertaken to synthesize contemporary research on entrepreneurship and business model innovation, thereby advancing scholarly understanding of current theoretical orientations, empirical methodologies, and substantive research findings. The objectives of this review encompass: (1) identifying predominant theoretical frameworks employed in entrepreneurship research, (2) characterizing empirical methodological approaches and their distributional patterns across publication venues, (3) examining how entrepreneurial processes unfold within stakeholder and ecosystem contexts, and (4) delineating high-priority research gaps and emergent research trajectories warranting future scholarly investigation.

This chapter aims to provide readers with a comprehensive overview of the evolving scholarship on entrepreneurship and business model innovation, highlighting both theoretical foundations and practical implications for academics, practitioners, and policymakers in the field.

2. Methodology

2.1 Search Strategy and Information Source

This systematic review was conducted in accordance with the PRISMA 2020 guidelines to ensure transparency and reproducibility in the

identification, screening, and selection of relevant studies. The literature search was performed in the Web of Science Core Collection database using a topic-based Boolean search strategy. The following search string was applied:

TS=(entrepreneurship OR startup*

OR "new venture" OR "business creation")

AND

TS=("business model*" OR "business model innovation" OR "value creation")

The search was executed during the first quarter of 2026, and all records retrieved from the database were exported in plain bibliographic format for further screening and descriptive analysis. The initial search yielded 100 records. After duplicate removal based on DOI information, 93 unique records remained for title and abstract screening.

2.2 Inclusion and Exclusion Criteria

For this review, studies were considered eligible for inclusion if they met the following criteria:

- Indexed in the Web of Science Core Collection.
- Published in English.
- Addressed entrepreneurship, entrepreneurial processes, or new venture creation.
- Explicitly examined business models, business model innovation, or value creation within an entrepreneurial context.

Studies were excluded if they:

- Focused on innovation or management without a clear connection to entrepreneurship.
- Addressed entrepreneurship but did not reference business models or mechanisms of value creation.
- Lacked sufficient conceptual or empirical relevance based on title and abstract screening.
- Were duplicate records.

As part of the preliminary screening, an automated keyword-based filter was applied to titles and abstracts, identifying 24 potentially relevant studies. These studies were then subjected to a closer, manual review. Final inclusion was determined based on substantive fit with the objectives of the review, rather than relying solely on automated filtering.

2.3 Screening and Selection Procedure

The chapter selection process followed a stepwise screening procedure. First, all retrieved records were exported from the Web of Science database. Second, duplicate entries were identified and removed using DOI metadata. Third, the remaining records were screened on the basis of titles and abstracts. This stage aimed to determine whether each study addressed the intersection of entrepreneurship and business model innovation.

The PRISMA-based screening process can be summarized as follows: 100 records were initially identified, 7 duplicate records were removed, and 93 records were retained for title and abstract screening. A preliminary automated relevance assessment flagged 24 studies as closely aligned with the study topic. These studies formed the basis for the subsequent in-depth evaluation.

2.4 Data Extraction and Analytical Procedure

Bibliographic data were processed and analyzed using Python. The exported Web of Science file was cleaned, standardized, and deduplicated before descriptive analyses were conducted. The analysis focused on publication year, source titles, author productivity, citation counts, and keyword frequencies.

The descriptive analysis showed that the dataset covered the period from 2005 to 2026, with visible concentrations in 2017 and 2024 (10 publications each). The most represented journals included the *Journal of Business Research* (n = 6), *Strategic Entrepreneurship Journal* (n = 6), and *International Entrepreneurship and Management Journal* (n = 5). Frequently occurring keywords included entrepreneurship (n = 36), innovation (n = 35), performance (n = 35), business model (n = 10), business model innovation (n = 9), and value creation (n = 9).

2.5 Limitations of the Search Procedure

Although the review provides a focused overview of the entrepreneurship–business model innovation literature, several limitations should be acknowledged. First, the search was limited to the Web of Science Core Collection, which may exclude relevant studies indexed elsewhere. Second, the search string was intentionally broad, which increased coverage but also introduced records with only partial thematic relevance. Third, the automated relevance filter served only as a preliminary support mechanism and does not substitute for full manual screening. Despite these limitations, the procedure provided a transparent and reproducible foundation for mapping the literature.

3. Results

3.1 Literature Selection and Descriptive Profile

The Web of Science search yielded 100 records. After DOI-based deduplication, 7 duplicate records were removed, leaving 93 unique studies for title and abstract screening. A preliminary automated relevance screening identified 24 studies as closely aligned with the intersection of entrepreneurship and business model innovation. These records were retained as the most directly relevant subset for closer thematic interpretation.

The temporal distribution of the 93 unique records indicates that the literature spans the period from 2005 to 2026, with a visible increase in publication activity after 2014. Publication peaks were observed in 2017 and 2024, with 10 publications each, followed by 2021 with 8 publications. This pattern suggests that scholarly attention to entrepreneurship and business model innovation has intensified in recent years, particularly in response to digital transformation, ecosystem thinking, and new venture growth dynamics.

The dataset is concentrated in prominent entrepreneurship, innovation, and management journals. The Journal of Business Research and the Strategic Entrepreneurship Journal each published 6 articles, followed by the International Entrepreneurship and Management Journal with 5 articles, and the International Journal of Entrepreneurship and Innovation and Research Policy with 4 articles each. This concentration indicates that the topic is anchored primarily in strategic entrepreneurship, innovation management, and applied business research.

Keyword frequency analysis further highlights the conceptual structure of the field. The most frequent terms were entrepreneurship (n = 36), innovation (n = 35), and performance (n = 35), followed by strategy (n = 17), knowledge (n = 14), and corporate entrepreneurship (n = 12). More specific terms related to the focal topic, such as business model (n = 10), business model innovation (n = 9), and value creation (n = 9), appeared less frequently but were still clearly represented. This distribution suggests that business model innovation is often embedded within broader discussions of entrepreneurial performance, strategic adaptation, and firm-level capability development rather than treated as an isolated construct.

Citation analysis reveals that several foundational contributions continue to shape the field. The most cited article in the dataset was "The entrepreneur's business model: toward a unified perspective" (Morris et al., 2005), with 1,214 citations, followed by "Business model design and the performance of entrepreneurial firms" (Zott & Amit, 2007), with 1,042 citations, and "Entrepreneurial innovation: The importance of context"

(Autio et al., 2014), with 899 citations. These highly cited studies indicate that the literature is built around enduring concerns with business model design, contextualized entrepreneurial innovation, and the performance implications of entrepreneurial action.

Overall, the results suggest that the entrepreneurship–business model innovation literature is both historically rooted and increasingly dynamic, with recent growth driven by research on ecosystems, digital innovation, strategic entrepreneurship, and new venture value creation.

3.2 Publication Year Distribution

As shown in Table 1, publication activity remained relatively limited before 2014, but increased substantially thereafter (figure 1). The strongest peaks occurred in 2017 and 2024, each with 10 publications, indicating renewed and sustained interest in the topic. This upward trajectory suggests that entrepreneurship and business model innovation have evolved into a more consolidated research domain, particularly within the broader contexts of innovation strategy and entrepreneurial ecosystems.

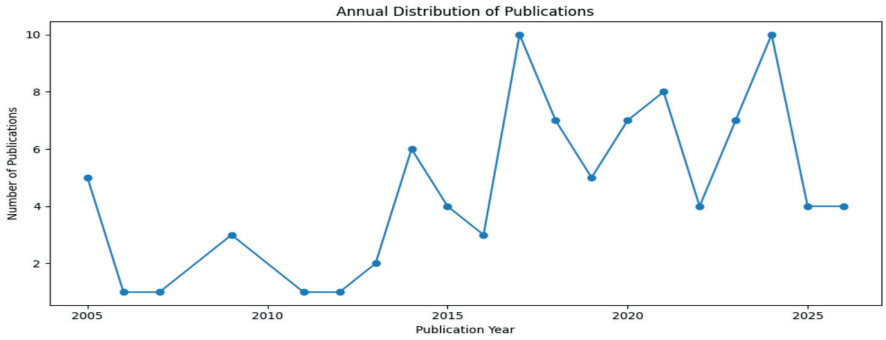

Figure 1. *Annual Distribution of Publications*

Table 1. *Year-wise distribution of publications (n = 93)*

Year	Publications
2005	5
2006	1
2007	1
2009	3
2011	1
2012	1
2013	2
2014	6
2015	4
2016	3
2017	10

2018	7
2019	5
2020	7
2021	8
2022	4
2023	7
2024	10
2025	4
2026	4

3.3 Leading Publication Sources

Table 2 shows that the literature is distributed across a set of highly visible entrepreneurship and management journals, with particularly strong representation in *Journal of Business Research* and *Strategic Entrepreneurship Journal*. The presence of journals such as *Research Policy*, *Technovation*, and *Technological Forecasting and Social Change* further suggests that the topic is strongly connected to innovation systems, technological change, and strategic renewal.

Table 2. *Top publication sources*

Journal	**Count**
Journal of Business Research	6
Strategic Entrepreneurship Journal	6
International Entrepreneurship and Management Journal	5
International Journal of Entrepreneurship and Innovation	4
Research Policy	4
Review of Managerial Science	2
Creativity and Innovation Management	2
Technovation	2
Technology in Society	2
Sustainability	2
Heliyon	2
Administrative Sciences	2
International Journal of Innovation Management	2
Industrial Marketing Management	2
Entrepreneurship Research Journal	2
Small Business Economics	2
International Journal of Entrepreneurial Behavior & Research	2
International Journal of Technology Management	2
Technological Forecasting and Social Change	2
Journal of Technology Transfer	2

3.4 Most Frequent Keywords

Keyword analysis reveals that the field is conceptually anchored in entrepreneurship, innovation, and performance (figure 2). Terms such as *dynamic capabilities*, *resource-based view*, *strategic entrepreneurship*, and *networks* indicate that the literature draws heavily on strategic management and capability-based explanations. The relatively lower frequencies of *business model innovation* and *value creation* suggest that these concepts often appear as part of broader entrepreneurial discussions rather than as narrowly bounded standalone research streams.

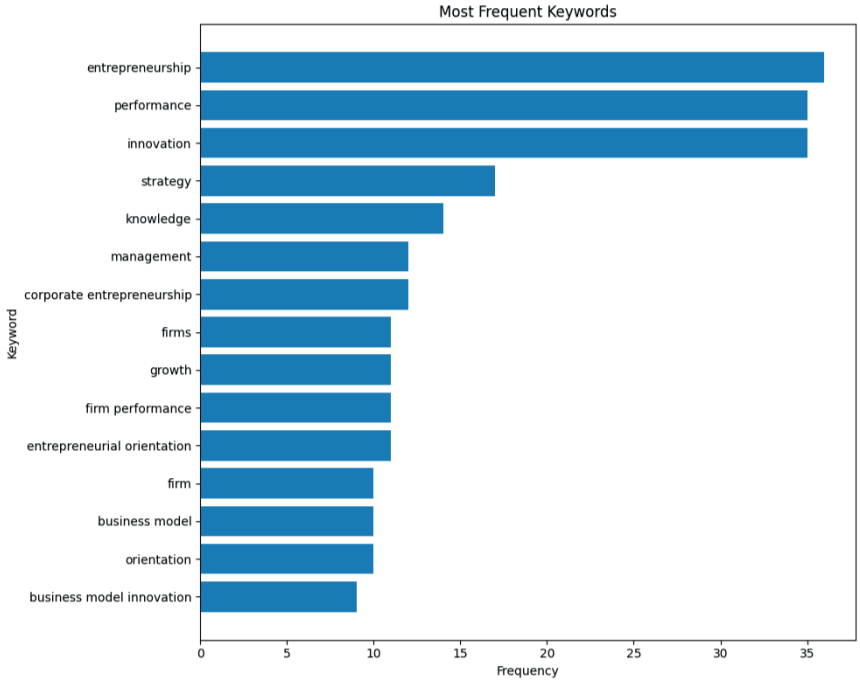

Figure 2. *Most Frequent Keywords*

3.5 Most Influential Studies

The citation profile confirms that the field is structured around a relatively small number of influential conceptual and integrative works. Foundational contributions by Morris et al. (2005) and Zott and Amit (2007) remain central, while later studies increasingly emphasize context, platforms, and open innovation. This indicates a gradual movement from static business model conceptualization toward more dynamic and ecosystem-oriented perspectives (table 3).

Table 3. *Most cited studies in the dataset*

Title	Authors	Journal	Year	Citations
The entrepreneur's business model: toward a unified perspective	Morris, M; Schindehutte, M; Allen, J	Journal of Business Research	2005	1214
Business model design and the performance of entrepreneurial firms	Zott, C; Amit, R	Organization Science	2007	1042
Entrepreneurial innovation: The importance of context	Autio, E; Kenney, M; Mustar, P; Siegel, D; Wright, M	Research Policy	2014	899
Business model innovation: Towards an integrated future research agenda	Schneider, S; Spieth, P	International Journal of Innovation Management	2013	410
Business model innovation - state of the art and future challenges for the field	Spieth, P; Schneckenberg, D; Ricart, JE	R&D Management	2014	356
On open innovation, platforms, and entrepreneurship	Nambisan, S; Siegel, D; Kenney, M	Strategic Entrepreneurship Journal	2018	325
Contextualizing entrepreneurial innovation: A narrative perspective	Garud, R; Gehman, J; Giuliani, AP	Research Policy	2014	278
Entrepreneurship in digital platforms: A network-centric view	Srinivasan, A; Venkatraman, N	Strategic Entrepreneurship Journal	2018	233
Business model innovation in entrepreneurship	Trimi, S; Berbegal-Mirabent, J	International Entrepreneurship and Management Journal	2012	222
Introduction to the SEJ special issue on business models	Demil, B; Lecocq, X; Ricart, JE; Zott, C	Strategic Entrepreneurship Journal	2015	207

3.6 Relevance Screening Results

The preliminary automated relevance checks classified 24 studies as directly relevant to the intersection of entrepreneurship and business model innovation, while 69 records were identified as more peripheral (table 4). This result indicates that, although the broader search strategy successfully captured a wide conceptual field, a substantial portion of the literature engages only indirectly with focal relationships. This supports the need for further manual screening and thematic refinement in the final synthesis.

Table 4. *Preliminary automated relevance screening*

Relevance status	Count
Relevant	24
Not relevant / less directly relevant	69

4. Discussion

4.1 Synthesis of Current Knowledge

The findings of this systematic review provide a structured overview of how entrepreneurship research has conceptualized and examined business model innovation over the past two decades. The bibliographic profile reveals that although foundational contributions emerged in the mid-2000s, the field experienced notable acceleration after 2014. This temporal pattern likely reflects broader structural changes in the entrepreneurial landscape, including digital transformation, platform-based business models, and the increasing importance of innovation ecosystems. As entrepreneurial activity has become more technology-intensive and globally interconnected, scholarly attention has increasingly shifted toward understanding how ventures design and adapt their business models in dynamic environments.

The keyword analysis suggests that literature is strongly embedded within the broader domains of innovation and strategic management. The dominance of terms such as *entrepreneurship*, *innovation*, *performance*, and *strategy* indicates that business model innovation is rarely studied in isolation. Instead, it is typically examined as part of a broader analytical framework linking entrepreneurial action to firm performance, strategic adaptation, and capability development. In particular, the recurring presence of concepts such as *dynamic capabilities*, *resource-based view*, and *strategic entrepreneurship* suggests that much of the literature conceptualizes business model innovation as a mechanism through which firms reconfigure resources and capabilities to maintain competitive advantage.

The citation structure further reinforces the centrality of several foundational theoretical contributions. Highly cited works by Morris et al. (2005), Zott and Amit (2007), and Autio et al. (2014) have played a pivotal role in shaping how scholars conceptualize entrepreneurial business models. These studies collectively emphasize that business models represent not merely operational structures but strategic architectures through which entrepreneurial firms create, deliver, and capture value. As a result, contemporary research increasingly views business model innovation as a dynamic process involving experimentation, adaptation, and iterative learning rather than as a one-time structural change.

Despite these theoretical advances, literature remains characterized by several structural gaps. First, theoretical perspectives often operate in parallel

rather than in an integrated manner. While resource-based, capability-based, institutional, and ecosystem perspectives are frequently invoked, relatively few studies attempt to synthesize these frameworks into a unified explanatory model. Second, empirical investigations remain heavily dominated by cross-sectional designs, limiting our ability to understand how entrepreneurial business models evolve over time. Finally, the geographic distribution of studies suggests a continued concentration in developed economies, raising concerns about potential contextual bias in existing theoretical assumptions.

4.2 Emerging Research Trajectories

The results of this review point to several emerging research trajectories that are likely to shape future entrepreneurship scholarship. One prominent trend is the increasing emphasis on entrepreneurial ecosystems. Rather than viewing entrepreneurship solely as an individual or firm-level phenomenon, recent studies emphasize the interconnected networks of institutions, investors, knowledge actors, and market participants that collectively shape entrepreneurial outcomes. Within such ecosystems, business model innovation becomes not only a firm-level capability but also a relational process influenced by collaborative networks and institutional environments.

A second emerging trajectory concerns the growing role of digital and platform-based entrepreneurship. Advances in digital technologies have enabled new forms of value creation that transcend traditional industry boundaries. Platform ecosystems, digital marketplaces, and data-driven business models have fundamentally altered the mechanisms through which entrepreneurial firms scale and compete. Consequently, business model innovation research increasingly examines issues such as digital platform governance, data monetization, and network effects.

A third trajectory involves the integration of stakeholder-centric perspectives. Traditional entrepreneurship research often focuses primarily on the entrepreneur or the founding team. However, recent scholarship emphasizes the importance of broader stakeholder engagement, including customers, partners, investors, and community actors. This shift reflects a growing recognition that entrepreneurial value creation is inherently collaborative and embedded within complex stakeholder networks.

Finally, sustainability and social entrepreneurship are emerging as important domains for business model innovation research. Increasing attention to environmental challenges, social impact, and sustainable development has prompted scholars to examine how entrepreneurial ventures design business models that simultaneously generate economic, social, and environmental value. This trend suggests that the concept of entrepreneurial success is gradually expanding beyond purely financial metrics toward more multidimensional forms of value creation.

4.3 Methodological Implications

From a methodological perspective, the review highlights several opportunities for strengthening future research in this domain. First, there is a clear need for longitudinal research designs that capture the temporal evolution of entrepreneurial business models. Since business model innovation often unfolds through iterative experimentation and strategic adaptation, cross-sectional approaches provide only a partial understanding of these processes. Panel data, repeated-measure designs, and event-based analyses could significantly enhance our ability to examine how entrepreneurial ventures transform their business models over time.

Second, mixed methods offer considerable promise for advancing the field. Quantitative studies provide valuable insights into generalizable patterns and relationships, while qualitative methods such as case studies, ethnography, and process tracing can illuminate the underlying mechanisms through which entrepreneurial actors develop and refine business models. Integrating these approaches may enable more comprehensive explanations of entrepreneurial innovation dynamics.

Third, future research could benefit from greater use of comparative and cross-national designs. Entrepreneurship is deeply embedded in institutional, cultural, and regulatory contexts, yet many existing studies rely on data from a limited set of developed economies. Comparative studies examining how entrepreneurial business models vary across institutional environments could significantly enrich theoretical understanding.

Fourth, advances in computational social science create new opportunities for analyzing entrepreneurial phenomena. Techniques such as network analysis, text mining, and machine learning can be applied to large-scale datasets including patent records, startup databases, and digital platform data to identify emerging patterns in entrepreneurial innovation. Such approaches may enable scholars to move beyond small-sample studies toward more comprehensive analyses of entrepreneurial ecosystems.

Finally, improving research transparency and reproducibility is increasingly important for cumulative knowledge development. Clear reporting of data sources, search strategies, and analytical procedures can enhance research credibility and facilitate future systematic reviews and meta-analyses.

4.4 Limitations

Several limitations of this systematic review should be acknowledged. First, the literature search was restricted to English-language publications indexed in the Web of Science database. Although this approach ensured high-quality and peer-reviewed sources, it may have excluded relevant research

published in other languages or indexed in alternative databases.

Second, the search strategy employed broad keyword combinations designed to capture a wide conceptual field. While this approach increased coverage, it also retrieved studies that were only indirectly related to business model innovation in entrepreneurship. Consequently, additional screening was required to identify the most relevant studies for thematic analysis.

Third, the heterogeneity of literature, particularly about theoretical frameworks, research designs, and empirical contexts, limited the feasibility of conducting a quantitative meta-analysis. Instead, the study relied on narrative synthesis to integrate findings across diverse research traditions.

Fourth, although bibliometric analysis provides valuable insights into publication trends and conceptual patterns, it cannot fully capture the substantive depth and contextual nuance of individual studies. As a result, the interpretation of emerging research trajectories should be viewed as indicative rather than definitive.

Finally, the rapidly evolving nature of entrepreneurial innovation, particularly in digital and platform-based contexts means that the field continues to develop quickly. New technological developments, regulatory changes, and market dynamics may reshape entrepreneurial business models in ways not fully reflected in the current literature.

Despite these limitations, this systematic review provides a comprehensive overview of contemporary research on entrepreneurship and business model innovation. By synthesizing existing knowledge and identifying key research gaps, the chapter contributes to a clearer understanding of how entrepreneurial ventures design, adapt, and transform business models within increasingly complex economic and technological environments.

5. Conclusion

This chapter sets out to systematically examine the evolving literature on entrepreneurship and business model innovation, with the aim of identifying dominant theoretical perspectives, methodological patterns, and emerging research directions. By synthesizing studies retrieved from the Web of Science database, this review provides a structured overview of how scholars have conceptualized and empirically examined the relationship between entrepreneurial processes and business model development.

The findings indicate that research at the intersection of entrepreneurship and business model innovation has expanded significantly over the past decade, particularly after 2014. This growth reflects broader transformations in the entrepreneurial landscape, including the rise of digital platforms, ecosystem-based innovation, and increasingly dynamic market environments.

Within this evolving context, business model innovation has emerged as a central mechanism through which entrepreneurial ventures create, deliver, and capture value.

The review also highlights the strong theoretical foundations underpinning this field. Much of the literature draws upon established frameworks from strategic management and innovation studies, particularly the resource-based view, dynamic capabilities theory, and strategic entrepreneurship perspectives. These frameworks collectively emphasize that entrepreneurial success depends not only on opportunity recognition but also on the ability to configure and reconfigure organizational resources in response to environmental change. At the same time, the analysis reveals that these theoretical perspectives often remain fragmented. Greater integration between capability-based, ecosystem-oriented, and stakeholder-centered frameworks may provide a more comprehensive understanding of entrepreneurial business model innovation.

From a conceptual standpoint, the chapter demonstrates that business model innovation in entrepreneurship is rarely treated as an isolated phenomenon. Instead, it is typically embedded within broader discussions of innovation strategy, entrepreneurial performance, and organizational adaptation. The frequent co-occurrence of concepts such as innovation, performance, strategic management, and dynamic capabilities suggests that business model innovation functions as a bridging construct connecting entrepreneurship research with adjacent fields such as strategic management, technology management, and innovation studies.

Another key contribution of this review lies in its identification of several emerging research trajectories. First, the growing prominence of ecosystem perspectives highlights the importance of inter-organizational relationships and institutional environments in shaping entrepreneurial outcomes. Second, digital technologies and platform-based business models are increasingly transforming the mechanisms through which entrepreneurial ventures scale and compete. Third, the expanding focus on sustainability and social entrepreneurship reflects a shift toward more holistic conceptions of value creation that encompass economic, social, and environmental dimensions. Together, these developments indicate that entrepreneurship research is moving toward more systemic and context-sensitive approaches.

Despite these advances, the review also reveals several important gaps that warrant further scholarly attention. Much of the existing literature relies on cross-sectional empirical designs, limiting our ability to understand the dynamic and evolutionary nature of entrepreneurial business models. Longitudinal studies tracking the development and transformation of ventures over time would significantly enhance theoretical understanding.

Additionally, comparative research examining how entrepreneurial business models vary across institutional and cultural contexts remains relatively limited. Expanding the geographic diversity of empirical studies may help address potential biases associated with the dominance of Western research contexts.

Future research may also benefit from methodological innovation. The increasing availability of large-scale entrepreneurial datasets, digital platform data, and innovation databases creates new opportunities for applying computational approaches such as network analysis, text mining, and machine learning. These methods may enable scholars to uncover previously unobserved patterns in entrepreneurial ecosystems and innovation networks.

In conclusion, this systematic review contributes to the entrepreneurship literature by synthesizing existing knowledge on business model innovation, highlighting the theoretical foundations of the field, and identifying key directions for future research. As entrepreneurial environments continue to evolve in response to technological change and global economic transformation, understanding how ventures design and adapt their business models will remain a central challenge for both scholars and practitioners. By mapping the current state of the literature and outlining promising research trajectories, this chapter provides a foundation for future investigations into the dynamic relationship between entrepreneurship and business model innovation.

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Chapter 2

INVESTIGATING THE MEDIATING ROLE OF INDIVIDUAL SELF-EFFICACY IN THE RELATIONSHIP BETWEEN EARTHQUAKE KNOWLEDGE LEVEL AND SUSTAINABLE EARTHQUAKE AWARENESS

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1. Introduction

Disasters are typically sudden and unforeseen events that result in widespread damage, destruction, and loss of life, often requiring response and assistance at national or international scales (Turan Bayraktar et al., 2024). Disasters, which have significant economic, social, and psychological impacts, have been increasing in number each year, and the destructive effects caused by this increase are also expanding (Sözen & Genç, 2023). Earthquakes, one of the inevitable and unpredictable disasters that occur during unforeseeable periods, have caused significant loss of life and property worldwide in recent years (Wu et al., 2022; Turan Bayraktar et al., 2024). Earthquakes occurring across the globe have also impacted Türkiye, leading to considerable human casualties and material damage. In Türkiye, over the past 100 years, a severe earthquake has occurred every two years, and a major earthquake every three years. (Tunç et al., 2024).

Situated at the convergence of the African, Arabian, Eurasian, and Anatolian tectonic plates, Türkiye is regarded as one of the most seismically active regions worldwide (Cheloni et al., 2023). As a result of this tectonic framework, Türkiye contains two major fault systems, the North Anatolian Fault Zone (NAFZ) and the East Anatolian Fault Zone (EAFZ), which are responsible for most of the seismic hazard in the country and are regarded as among the most active continental transform fault zones worldwide, making them high risk areas in Türkiye (Cheloni et al., 2023; Över et al., 2023). Erzincan province is largely located on a deep alluvial basin near the NAFZ (Cabalar et al., 2021). Since the Erzincan earthquake of 27.12.1939 clarified the presence and activity of the North Anatolian Fault Zone (NAFZ), scientific investigations on this fault system have been carried out continuously up to the present (Kıranşan, 2022).

The Erzincan earthquake (Mw = 7.9), which struck Erzincan Province and nearby regions on 27.12.1939, is regarded as the highest-magnitude seismic event recorded in Anatolia from the nineteenth century to the present (Yıldız & Dursun, 2021; Yaşar, 2023; Türkkan Tunalı, 2023; Koçbulut, 2023). The earthquake, centred in Erzincan, also caused deaths in the provinces of Gümüşhane, Sivas, Tokat, Amasya, Çorum and Giresun. As a result of the earthquake, a total of 32,968 people lost their lives in these cities, and 116,720 buildings were destroyed. In this earthquake, 15,600 people lost their lives, 4,125 were injured, 2,684 buildings collapsed, and 10,721 buildings were damaged in Erzincan (Tuğluoğlu, 2015). After this major event, Erzincan experienced another destructive earthquake with a magnitude of Mw = 6.8 on **13.03.1992** (Cabalar et al., 2021). This earthquake resulted in 653 fatalities and damage to 8,057 buildings (Şenol, 2020). Owing to these repeated seismic events, earthquakes are regarded as the most critical natural hazards affecting Erzincan (Akar et al., 2024).

Many earthquake studies conducted in Türkiye predict that earthquakes are likely to occur in the future as well (Yalman & Yalman, 2019; Gezer & Şahin, 2022). If the necessary precautions are not taken, earthquakes can lead to serious and severe consequences (Gür Erdoğan & Şimşek, 2023). Raising individuals' awareness and knowledge about earthquakes, and educating them on what to do before, during, and after an earthquake, has a significant impact on their preparedness and is therefore crucial in mitigating the negative effects of earthquakes. (Becker et al.,2012; Aksoy & Sözen, 2014; Yalman & Yalman, 2019; Hastuti et al., 2020; Gezer & Şahin, 2022; Fazeli et al., 2024).

It is not possible to accurately and simultaneously predict all three key parameters of an earthquake its location, magnitude, and timing (Pal et al., 2022; Kılıçbey et al., 2024). Nevertheless, through adequate earthquake awareness and educational preparedness, earthquakes need not result in disasters, and their adverse impacts can be substantially reduced (Öztürk & Şahinöz, 2018; Chaudhary & Piracha, 2021; Akar et al., 2024; Kılıçbey et al., 2024). Given the global increase in disasters and the damage they cause every year, it is crucial to develop a comprehensive disaster and earthquake awareness (Sözen & Genç, 2025).

2. Theoretical Background and Hypotheses Development

Individuals' knowledge about earthquakes plays a crucial role in shaping their level of earthquake preparedness (Çavuş & Balçın, 2020; Ao et al., 2021; Turan Bayraktar et al., 2024). It is vital to be prepared for earthquakes (Tsai, 2001) and to have sustainable earthquake awareness (Ross & Shuell, 1993). Sustainable earthquake awareness is a dynamic, evolving, and continuously self-renewing form of consciousness that is based not only on sufficient knowledge of the geographical characteristics of a given region but also on research grounded in knowledge and skills related to the pre-, during-, and post-earthquake phases (Demirci & Yıldırım, 2015). This is a key factor in effectively managing and mitigating the impacts of disasters (Xu et al., 2019; Turan Bayraktar et al., 2024). Communities with insufficient levels of sustained earthquake awareness may struggle to perform effectively during the preparation, emergency response, and post-disaster recovery stages of seismic events (Yolcu & Bekler, 2020). Preparedness encompasses the set of measures and practices designed to support timely and efficient responses, thereby reducing loss of life and property damage. Therefore, preventive measures and improving community preparedness are crucial for earthquake damage reduction (Rezabeigi Davarani et al., 2023). Nevertheless, it is known that the damages caused by earthquakes are much less in societies that are sufficiently informed about the earthquake risk of the place where they live and the possible damages of the earthquake (Cin, 2010; Dölek, 2019; Gezer & Şahin, 2022; Kılıçbey et al., 2024). However, knowledge alone may not be sufficient for effective preparation behaviour. According to Bandura's Social

Cognitive Theory, self-efficacy, which is one of the basic cognitive components that affect individuals' behaviours, refers to the individual's belief in his/her ability to perform the desired behaviour in a given situation (Bandura, 1977; Benight & Bandura, 2004; Armaş et al., 2017; Muslichah, 2018). Bandura's social cognitive theory emphasizes that it is not sufficient for an individual to merely acquire the relevant skills and abilities to successfully perform a task; it is also essential that the individual possesses a sense of self-efficacy, that is, the belief in their capability to accomplish the task under challenging conditions. The emergence of effective performance is closely related to the strength of the individual's belief in their ability to appropriately utilize these acquired skills (Bhati & Sethy, 2022). In the transformation of knowledge into behaviour, individuals' beliefs in their own capacities, i.e. their self-efficacy levels, play a decisive role.

Self-efficacy plays a critical role in shaping individuals' behaviours, their resilience in the face of adversity, and their ability to cope with stress (Meyer et al., 2022). Individuals with high levels of self-efficacy tend to adopt more effective post-disaster coping strategies, which can foster psychological resilience and facilitate post-traumatic growth (İme et al., 2025). Likewise, research on earthquake survivors has highlighted that self-efficacy is a key determinant of resilience and stress-coping mechanisms (Bhattarai et al., 2018; Liang & Su, 2011).

Examining previous studies, Sözen and Genç (2023), in their study to investigate the relationship between earthquake knowledge levels and sustainable earthquake awareness of university students, stated that there is a significant relationship between earthquake knowledge level and sustainable earthquake awareness. Han et al. (2021), in their study to determine the earthquake awareness of participants who experienced the Pohang earthquake in South Korea in 2017, found that individuals who experienced an earthquake had higher earthquake awareness levels than individuals who did not experience an earthquake. Gür Erdoğan and Şimşek (2023) examined the relationship between teachers' sustainable earthquake awareness levels and earthquake knowledge levels. As a result of their analysis, they found that the sustainable earthquake awareness levels of the participants did not differ according to gender and age, while their earthquake knowledge levels did not differ according to gender but differed according to age. They also stated that there was a positive relationship between the earthquake knowledge levels of the participants and their sustainable earthquake awareness levels. Turan Bayraktar et al. (2024) investigated how university students' levels of earthquake knowledge relate to their sustainable earthquake awareness and reported a statistically significant association between these variables. Similarly, Sözen and Genç (2025) analyzed the link between students' earthquake-related knowledge and sustainable earthquake awareness, concluding that greater

knowledge had a significant and positive effect on sustaining earthquake awareness. The study emphasised that increasing students' knowledge about earthquakes contributes significantly to the development of sustainable earthquake awareness and earthquake preparedness behaviours in the long term. Kılıçbey et al. (2024) tried to determine the relationship between sustainable earthquake awareness and earthquake knowledge levels of pre-service teachers studying at the faculties of education of universities in 11 provinces affected by the Kahramanmaraş centered earthquakes on February 6, 2023. The results showed that pre-service teachers' earthquake knowledge levels were at a moderate level, while their sustainable earthquake awareness was relatively low. Topal et al. (2024) examined the social and cognitive factors affecting individual-level earthquake preparedness in Istanbul using an extended model that includes earthquake risk perception within the framework of social cognitive theory (SCT). The results showed that earthquake preparedness behaviour is more closely related to cognitive factors, especially self-efficacy and risk perception. Kinanthi et al. (2023), in their study examining the factors affecting students' preparedness levels for earthquake disasters, found that students' knowledge level and self-efficacy partially significantly influenced earthquake preparedness behaviours, but that the experience variable had no significant effect on this behaviour. Gündüz et al. (2024) explored the associations between individuals' perceptions of earthquake risk, their level of earthquake-related knowledge, and sustainable earthquake awareness across multiple variables. Their findings indicated that both earthquake knowledge and risk perception significantly influence sustainable earthquake awareness and serve as meaningful predictors of it.

When the studies on earthquake knowledge level and sustainable earthquake awareness are examined, it is observed that both national and international literature have addressed the topic from different perspectives and contributed various findings to the field. In most of these studies, the relationships among earthquake knowledge level, risk perception, and sustainable earthquake awareness have been investigated. However, in developing sustainable earthquake awareness against such a destructive natural phenomenon as an earthquake, it is considered that knowledge level alone is not sufficient; determining the role of individual self-efficacy in this relationship is also of great importance. In this context, examining the mediating role of the individual self-efficacy variable in the present study will provide a new perspective in explaining the effect of earthquake knowledge level on sustainable earthquake awareness. This, in turn, has the potential to establish an original and holistic framework for understanding individuals' cognitive and behavioural preparedness toward earthquakes. In line with the theoretical framework of the research and the relevant literature, the following hypotheses are proposed.

H1: Earthquake knowledge level has an effect on sustainable earthquake awareness.

H2: Earthquake knowledge level has an effect on individual self-efficacy.

H3: Individual self-efficacy has an impact on sustainable earthquake awareness.

H4: Individual self-efficacy plays a mediating role in the relationship between earthquake knowledge level and sustainable earthquake awareness.

3. Methodology

3.1.Purpose and Importance of the Research

Historically, cities in Türkiye situated along active fault lines have experienced numerous major earthquakes, resulting in substantial human and material losses. The consequences of these events are commonly assessed through indicators such as fatalities, injuries, structural damage, and broader socioeconomic impacts. With today's technology, it is not possible to predict or prevent earthquakes in advance. Nevertheless, strengthening natural hazard perception through awareness-building and educational efforts can help prevent earthquakes from turning into large-scale disasters or substantially lessen their adverse effects. Accordingly, this study aims to investigate the influence of individuals' earthquake knowledge levels on sustainable earthquake awareness, with particular emphasis on the mediating role of individual self-efficacy. At this point, the research suggests that knowledge level and self-efficacy should be considered together for individuals to develop sustainable awareness against a destructive natural event such as earthquake. When an individual has knowledge but lacks the belief that he/she will transform this knowledge into behaviour, the protective attitudes and behaviours that he/she should exhibit during and after the earthquake remain incomplete. In addition, sustainable earthquake awareness is possible not only through immediate knowledge and attitudes, but also through long-term cognitive and behavioural internalization. Therefore, the research is important for individuals to develop long-term awareness and preparedness against earthquake risk Furthermore, the findings of this study are expected to inform the development and structuring of educational content for groups that are likely to become future decision-makers in society.

3.2. Research Model

Quantitative research method was used in the study. Since the research seeks to explain the relationships between variables and the reasons for these relationships, it has both a relationship-seeking and causal comparison research design. The model developed in line with the purpose and scope of the research is presented in Figure 1.

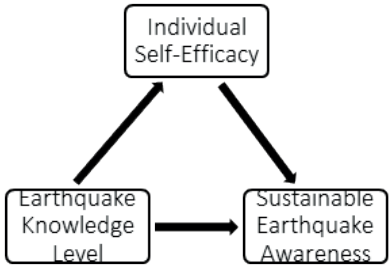


Figure 1. Research model

3.3. Population and Sample

The population of the study consists of individuals aged 18 years and over who have previously experienced earthquakes and live in Erzincan Province. Due to some constraints (time, cost, etc.), the sample size determination formula used in cases where the number of the main mass is unknown was utilized.

In this context, the minimum sample size was determined as 384 people based on 95% confidence interval and 5% margin of error using the equation (1) (Malhotra et al., 2017).

$$n = \frac{\Pi\,(1-\Pi)}{(e\,/\,Z)^2} \tag{1}$$

In the equation (1); n: sample size, Π: Population proportion, e: Margin of error, Z: Z-score corresponding to the confidence level

Since it was not possible to reach the entire population, convenience sampling method was preferred, and 392 participants constituted the sample size of the study. Therefore, it is seen that the sample size is sufficient. This method is a practical approach that is frequently used due to its saving in terms of time and cost (Ural & Kılıç, 2021). The findings obtained are valid for this sample and cannot be generalized for individuals who have not experienced earthquakes before.

3.4. Data Collection Methods and Tools

The data for this study were collected using a survey method, with a structured questionnaire serving as the primary data collection instrument. Ethical approval for the research was granted by the Erzincan Binali Yıldırım University Social and Human Sciences Ethics Committee (decision dated 07.05.2025, No. E-88012460-050.04-448076). All stages of the study were conducted in compliance with established ethical standards. The questionnaire form was applied to the participants online and the data collection process was carried out between May 10 and June 10, 2025. Within the scope of the research, the questionnaire form was delivered to a total of 433 people, and

the participants were asked whether they had experienced an earthquake before through a priori question. The 406 participants who answered "Yes" to this question were allowed to continue the survey. However, 14 of the 406 questionnaires were excluded from the evaluation as they were answered in the relevant field despite the warning "Please leave this question blank". As a result, a total of 392 valid questionnaires were taken into consideration in the analysis.

The questionnaire consists of five main sections. In the first section, the participants were asked "Have you experienced an earthquake before?" as a preliminary question. Participants who answered "Yes" to the preliminary question were able to continue the research. The second section includes questions about earthquake knowledge level; the third section includes questions about sustainable earthquake awareness; and the fourth section includes questions about individual self-efficacy variable. In the last section, demographic questions were included. The scales containing statements related to the research variables were obtained from various studies in the literature and adapted for the purposes of this research.

The "Earthquake Knowledge Level" scale, consisting of 19 knowledge items and developed by Genç and Sözen (2022), was created through validity and reliability analyses. The levels of the scale were measured using a 5-point Likert rating. The Likert-type statements are as follows: "Strongly disagree," "Disagree," "Neutral," "Agree," and "Strongly agree." All statements in the scale are in positive form; there are no reverse-coded items. As a result of the exploratory factor analysis conducted for this scale, it was determined that the scale consists of three sub-dimensions. In this context, the first dimension was defined as "Knowledge of Earthquake Zone Distribution," the second dimension as "Knowledge of Earthquake Effects," and the third dimension as "Earthquake Education." The first sub-dimension is represented by seven (7) items, the second sub-dimension by seven (7) items, and the third sub-dimension by five (5) items in the scale.

The "Sustainable Earthquake Awareness" scale, consisting of 22 knowledge items and developed by Genç and Sözen (2021), was created through validity and reliability analyses. The levels of the scale were measured using a 5-point Likert rating. The Likert-type statements are as follows: "Strongly disagree," "Disagree," "Neutral," "Agree," and "Strongly agree." All items in the scale are in positive form; there are no reverse-coded items. As a result of the exploratory factor analysis conducted for this scale, it was determined that the scale consists of three sub-dimensions. In this context, the first dimension was defined as "Earthquake-Structure Relationship," the second dimension as "Earthquake Preparedness Practice," and the third dimension as "Earthquake Preparedness." The first sub-dimension is represented by four (4) items, the second sub-dimension by eleven (11) items, and the third sub-dimension by seven (7) items in the scale.

The Individual Self-Efficacy scale was adapted for the present study, based on Armaş et al. (2017). The original form of the scale consists of seven items. In this study, the levels of the scale were measured using a 5-point Likert rating. The Likert-type statements are as follows: "Strongly disagree," "Disagree," "Neutral," "Agree," and "Strongly agree." All items in the scale are in negative form.

3.5. Statistical Analysis

In the study, the survey responses of 392 participants were analysed using IBM SPSS v23 and IBM AMOS v24 statistical software. The analysis procedure sequentially included descriptive statistics, tests of normality, confirmatory factor analysis (CFA), reliability assessment, and structural equation modelling (SEM). Statistical significance was evaluated at the $p < 0.05$ level.

4. Results

4.1. Profile of the Participants

Table 1 summarizes the demographic characteristics of the participants. Among the respondents, 35.5% (n = 139) were women and 64.5% (n = 253) were men. The largest proportions of participants were observed in the 34–41 age group, accounting for 23.0% (n = 90), followed by the 42–49 age group with 22.5% (n = 88). According to the marital status of the participants, 72.7% (n=285) were married and 42.5% (n=165) were undergraduate graduates. In terms of income level, 40% (n=157) earn up to three times the minimum wage and above, while 94.4% (n=370) live in the city centre.

Table 1. *Profile of the Participants (N=392)*

	Frequency	Percent (%)
Gender		
Female	139	35.5
Male	253	64.5
Age		
18 and 25	57	14.5
26 and 33	57	14.5
34 and 41	90	23.0
42 and 49	88	22.5
50 and 57	48	12.2
58 and over	52	13.3
Marital status		
Married	285	72.7
Single	107	27.3
Education status		
Primary school graduate	11	2.8

High school graduate	59	15.0
Two-year degree graduate	50	12.8
Bachelor's degree graduate	165	42.1
Postgraduate degree holder	107	27.3
Monthly Income		
Minimum wage	103	26.3
Up to twice the minimum wage	132	33.7
Three times the minimum wage or more	157	40.0
Region of Residence		
City centre	370	94.4
District	22	5.6

4.2. Confirmatory Factor Analysis (CFA)

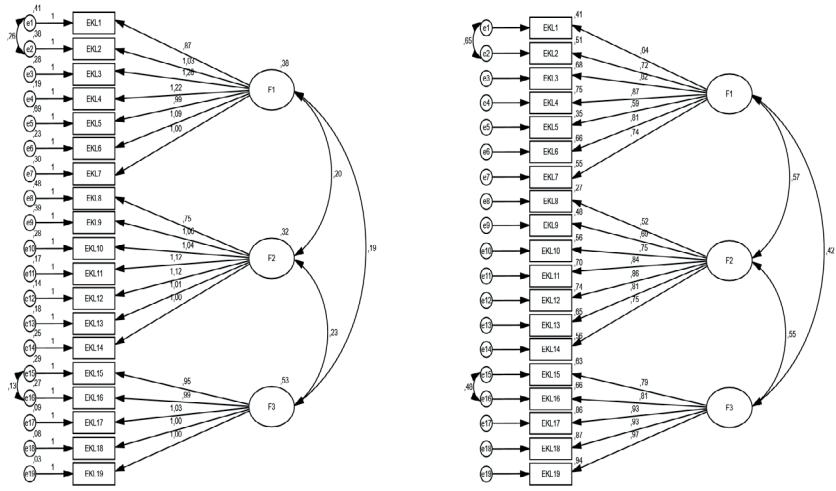
The results of Confirmatory Factor Analysis (CFA) of earthquake knowledge level are presented in Table 2. The conformity of the dataset to a normal distribution was assessed using a multivariate normality test, which indicated that the normality assumption was violated (critical value = 111.148). Accordingly, because the data did not meet the normal distribution assumption, the Bootstrap Maximum Likelihood method was employed for the analyses. (Gürbüz, 2024).

Table 2. *Results of the Earthquake Knowledge Level (EKL) Scale*

			β^1 (%95 CI)	β^2 (%95 CI)	Standard Error	p	R^2
EKL1	<---	F1	0.873 (0.709-1.079)	0.642 (0.538-0.730)	0.093	**<0.001**	0.412
EKL2	<---	F1	1.033 (0.818-1.286)	0.715 (0.613-0.801)	0.118	**<0.001**	0.512
EKL3	<---	F1	1.263 (1.080-1.529)	0.825 (0.768-0.873)	0.113	**<0.001**	0.680
EKL4	<---	F1	1.224 (1.050-1.478)	0.865 (0.819-0.905)	0.107	**<0.001**	0.748
EKL5	<---	F1	0.989 (0.825-1.185)	0.589 (0.502-0.664)	0.091	**<0.001**	0.347
EKL6	<---	F1	1.09 (0.972-1.234)	0.814 (0.744-0.870)	0.066	**<0.001**	0.662
EKL7	<---	F1	1 (1-1)	0.744 (0.657-0.816)	...	**...**	0.553
EKL8	<---	F2	0.748 (0.498-0.958)	0.522 (0.343-0.661)	0.116	**<0.001**	0.272
EKL9	<---	F2	1.062 (0.918-1.271)	0.694 (0.571-0.789)	0.088	**<0.001**	0.482
EKL10	<---	F2	1.041 (0.909-1.169)	0.746 (0.615-0.836)	0.065	**<0.001**	0.557
EKL11	<---	F2	1.116 (0.923-1.423)	0.839 (0.777-0.892)	0.126	**<0.001**	0.705
EKL12	<---	F2	1.121 (0.962-1.407)	0.859 (0.800-0.914)	0.113	**<0.001**	0.739
EKL13	<---	F2	1.009 (0.818-1.213)	0.805 (0.693-0.885)	0.098	**<0.001**	0.649
EKL14	<---	F2	1 (1-1)	0.750 (0.623- 0.841)	...	**...**	0.562
EKL15	<---	F3	0.949 (0.853-1.044)	0.792 (0.727-0.847)	0.048	**<0.001**	0.627
EKL16	<---	F3	0.993 (0.911-1.074)	0.814 (0.754-0.865)	0.042	**<0.001**	0.663
EKL17	<---	F3	1.033 (0.981-1.090)	0.929 (0.893-0.958)	0.027	**<0.001**	0.864
EKL18	<---	F3	1.001 (0.949-1.058)	0.931 (0.905-0.954)	0.028	**<0.001**	0.867
EKL19	<---	F3	1 (1-1)	0.969 (0.947-0.986)	...	**...**	0.939

*** β^1: Unstandardized path coefficient; β^2: Standardized path coefficient; %95 CI: %95 Confidence Interval**

Modifications were made between items e1 and e2 and items e15 and e16 in order to keep the model fit values within acceptable limits. When the model fit values after the modifications were examined; CMIN/DF=3.437, GFI=0.876, CFI=0.940, RMSEA=0.079, IFI=0.940, TLI=0.930 and SRMR=0.050 and these values are within acceptable limits. The earthquake knowledge level scale is divided into 3 sub-dimensions. The statements between EKL1-7 are named as "Earthquake Regions Distribution Aspect", the statements between EKL8-14 are named as "The effects of Earthquake Aspect" and the statements between EKL15-19 are named as "Earthquake Education Aspect". All path coefficients in the model were statistically significant ($p<0.05$). Path Coefficients of CFA Results of the Earthquake Knowledge Level Scale are presented in Figures 2.



a) *b)*

Figure 2. a) Unstandardized Path Coefficients of CFA Results of Earthquake Knowledge Level Scale b) Standardized Path Coefficients of CFA Results of Earthquake Knowledge Level Scale

Table 3. *CFA Results of the Sustainable Earthquake Awareness Scale*

			β^1 (%95 CI)	β^2 (%95 CI)	Standard Error	p	R^2
SEA1	<---	F1	2.019 (1.424-3.176)	0.853 (0.792-0.908)	0.479	**<0.001**	0.728
SEA2	<---	F1	2.02 (1.434-3.173)	0.832 (0.762-0.889)	0.462	**<0.001**	0.692
SEA3	<---	F1	1.197 (0.859-1.821)	0.475 (0.372-0.573)	0.255	**<0.001**	0.226
SEA4	<---	F1	1 (1-1)	0.363 (0.237-0.486)	...	...	0.132
SEA5	<---	F2	0.843 (0.644-1.062)	0.53 (0.421-0.625)	0.108	**<0.001**	0.280
SEA6	<---	F2	0.815 (0.611-1.031)	0.547 (0.430-0.649)	0.107	**<0.001**	0.299
SEA7	<---	F2	0.854 (0.689-1.035)	0.587 (0.492-0.672)	0.089	**<0.001**	0.345
SEA8	<---	F2	0.904 (0.766-1.056)	0.623 (0.535-0.701)	0.075	**<0.001**	0.389
SEA9	<---	F2	1.009 (0.825-1.220)	0.663 (0.571-0.746)	0.098	**<0.001**	0.440
SEA10	<---	F2	0.971 (0.792-1.183)	0.675 (0.588-0.748)	0.098	**<0.001**	0.455
SEA11	<---	F2	0.682 (0.532-0.853)	0.604 (0.503-0.69)	0.081	**<0.001**	0.364
SEA12	<---	F2	0.919 (0.747-1.124)	0.691 (0.605-0.762)	0.096	**<0.001**	0.477
SEA13	<---	F2	0.955 (0.816-1.117)	0.629 (0.536-0.708)	0.077	**<0.001**	0.396
SEA14	<---	F2	0.951 (0.794-1.125)	0.604 (0.512-0.683)	0.084	**<0.001**	0.365
SEA15	<---	F2	1 (1-1)	0.671 (0.593-0.736)	...	...	0.450
SEA20	<---	F3	0.954 (0.811-1.115)	0.802 (0.707-0.885)	0.077	**<0.001**	0.644
SEA21	<---	F3	0.698 (0.563-0.834)	0.659 (0.545-0.757)	0.069	**<0.001**	0.434
SEA22	<---	F3	1 (1-1)	0.863 (0.772-0.942)	...	...	0.745

*** β^1: Unstandardized path coefficient; β^2: Standardized path coefficient; %95 CI: %95 Confidence Interval**

Confirmatory Factor Analysis (CFA) results of the sustainable earthquake awareness scale are presented in Table 3. The assumption of multivariate normality was tested, and the results indicated a deviation from normal distribution (critical value = 31.953). Therefore, due to the violation of the normality assumption, the Bootstrap Maximum Likelihood method was adopted for the estimation process. (Gürbüz 2024). Since the factor loadings of SEA16, SEA17, SEA18 and SEA19 items were negative, they were removed from the model. Modifications were made between error terms e3 and e4, error terms e5 and e7, error terms e5 and e9, error terms e9 and e10, and error terms e6 and e10 in order to keep the model fit values within acceptable limits. When the model fit values were examined after the modifications, CMIN/DF=3.391, GFI=0.878, CFI=0.897, RMSEA=0.078, IFI=0.898, TLI=0.876 and SRMR=0.073 were obtained and these values are within acceptable limits. The sustainable earthquake awareness scale is divided into 3 sub-dimensions. Statements between SDF1-4 are named as "Earthquake Structure Relationship", statements between SEA5-15 are named as "Earthquake Preparation Application" and statements between SEA20-22 are named as "Earthquake Preparedness" sub-dimensions. All path coefficients in the model were statistically significant ($p<0.05$). Path Coefficients of CFA Results of the Sustainable Earthquake Awareness Scale are presented in figures 3.

Table 4. *CFA Results of the Individual Self-Efficacy Scale*

			β¹ (%95 CI)	β² (%95 CI)	Standard Error	p	R²
ISE1	<---	F1	1.374 (1.084-1.812)	0.658 (0.571-0.732)	0.185	**<0.001**	0.432
ISE2	<---	F1	1.475 (1.198-1.925)	0.779 (0.720-0.831)	0.185	**<0.001**	0.607
ISE3	<---	F1	1.708 (1.359-2.278)	0.873 (0.827-0.914)	0.232	**<0.001**	0.762
ISE4	<---	F1	1.715 (1.369-2.289)	0.901 (0.863-0.934)	0.232	**<0.001**	0.811
ISE5	<---	F1	1.695 (1.357-2.227)	0.831 (0.767-0.883)	0.224	**<0.001**	0.691
ISE6	<---	F1	1.236 (0.941-1.633)	0.518 (0.403-0.621)	0.178	**<0.001**	0.268
ISE7	<---	F1	1 (1-1)	0.454 (0.349-0.554)	...	...	0.207

*** β¹: Unstandardized path coefficient; β²: Standardized path coefficient; %95 CI: %95 Confidence Interval**

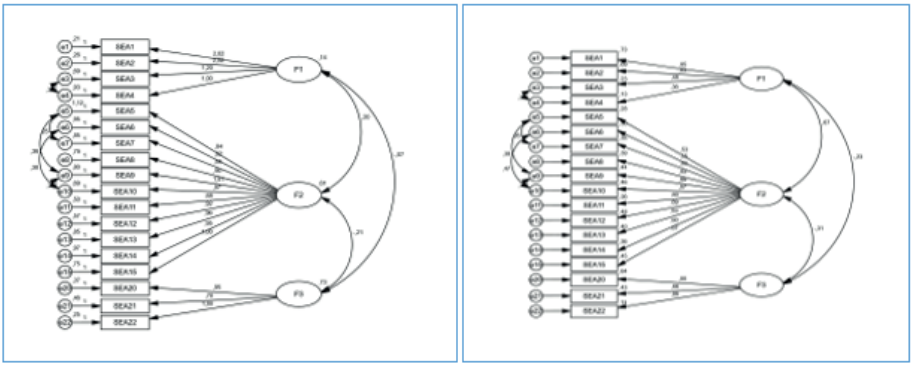


Figure 3. a)*Unstandardized Path Coefficients of CFA Results of Sustainable Earthquake Awareness Scale. b) Standardized Path Coefficients of CFA Results of Sustainable Earthquake Awareness Scale*

Table 4 presents the results of the Confirmatory Factor Analysis (CFA) conducted for the individual self-efficacy scale. The assumption of multivariate normality was assessed, and the findings revealed that the dataset deviated from a normal distribution (critical value = 26.362). Consequently, because the normality assumption was not satisfied, the Bootstrap Maximum Likelihood method was employed for parameter estimation (Gürbüz, 2024). Modifications were made between error terms e1 and e2, error terms e6 and e7 in order to keep the model fit values within acceptable limits. An evaluation of the model fit indices following the applied modifications yielded CMIN/DF = 2.989, GFI = 0.975, CFI = 0.984, RMSEA = 0.071, IFI = 0.984, TLI = 0.972, and SRMR = 0.032, all of which fall within acceptable threshold values. All path coefficients in the model were statistically significant ($p<0.05$). The Path Coefficients of the CFA Results of the Individual Self-Efficacy Scale are presented in figures 4

Table 5. *Model Fit Statistics*

	Good fit	Acceptable fit	Earthquake Knowledge Level	Sustainable Earthquake Awareness Scale	Individual Self-Efficacy Scale
CMIN/DF	<3	3<CMIN/DF<5	3.437	3.391	2.989
GFI	>0.95	>0.90	0.876	0.878	0.975
CFI	>0.95	>0.90	0.940	0.897	0.984
RMSEA	<0.05	<0.08	0.079	0.078	0.071
IFI	>0.95	>0.90	0.940	0.898	0.984
TLI	>0.95	>0.90	0.930	0.876	0.972
SRMR	<0.05	<0.08	0.050	0.073	0.032

When examining the model fit values for the Earthquake Knowledge Level, the overall fit of the model is within acceptable limits. However, the GFI value falling below the threshold is considered a limitation. When examining the model fit values for the Sustainable Earthquake Awareness Scale, it is seen that several indices (GFI, CFI, IFI, TLI) in this model fall below the acceptable limit. However, the RMSEA, SRMR, and CMIN/DF values are within acceptable limits. Overall, the model shows an acceptable fit; however, this scale exhibited the weakest fit among the three models. When examining the model fit values for the Individual Self-Efficacy Scale, the fit indices for this model are generally within good fit limits. Only the RMSEA value is within acceptable limits. Overall, the strongest fit was obtained for the Individual Self-Efficacy Scale (Table 5).

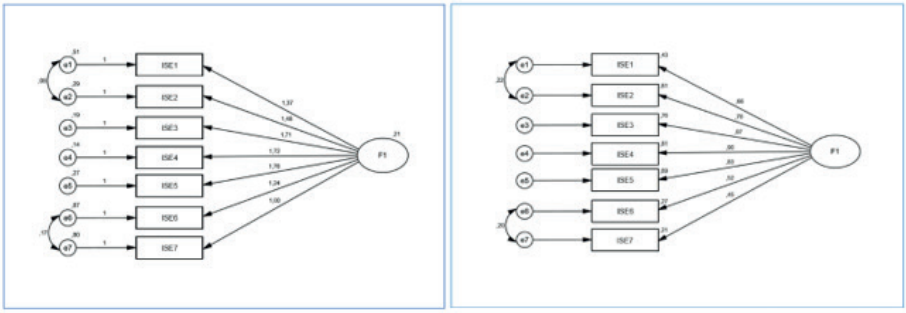


Figure 4. a) *Unstandardized Path Coefficients of Individual Self-Efficacy Scale CFA Results. b) Standardized Path Coefficients of Individual Self-Efficacy Scale CFA Results*

4.3. Reliability Analysis

The average score of the "Earthquake Regions Distribution Aspect" sub-dimension is 26.71 and Cronbach's Alpha value is 0.898, which is highly reliable. The average score of the "The effects of Earthquake Aspect" sub-dimension was

30.52 and Cronbach's Alpha value was 0.895 with high reliability. The average score of the "Earthquake Education Aspect" sub-dimension was 20.4 and the Cronbach's Alpha value was 0.952 with high reliability. The average score of the "Earthquake Knowledge Level" scale was 77.63 and the Cronbach's Alpha value was 0.929 with high reliability. The average score of the "Earthquake Structure Relationship" sub-dimension was 13.93 and the Cronbach's Alpha value was 0.727, which is highly reliable. The average score of the "Earthquake Preparation Application" sub-dimension is 34.35 and Cronbach's Alpha value is 0.880, which is highly reliable. The average score of the "Earthquake Preparedness" sub-dimension was 11.36 and the Cronbach's Alpha value was 0.817 with high reliability. The average score of the "Sustainability Earthquake Awareness" scale was 59.64 and the Cronbach's Alpha value was 0.839 with high reliability. The average score of the "Self-Efficacy" scale was 2.65 and the Cronbach's Alpha value was 0.881 with high reliability. The Cronbach's Alpha values of all variables are above 0.70, which shows that the scales are highly reliable (Cronbach, 1951; Alem et al., 2016) (Table 6).

Table 6. *Descriptive Statistics and Cronbach's Alpha Values of the Scales*

	Mean ± Standard Deviation	**Median (min-max)**	**Cronbach's Alpha**	**McDonal's w**
Earthquake Regions Distribution Aspect	26.71±4.91	27 (7-35)	0.898	0.903
The effects of Earthquake Aspect	30.52±4.28	30 (7-35)	0.895	0.900
Earthquake Education Aspect	20.40±3.78	20 (5-25)	0.952	0.954
Earthquake Knowledge Level	77.63±10.51	77 (25-95)	0.929	0.932
Earthquake Structure Relationship	13.93±2.81	14 (4-20)	0.727	0.750
Earthquake Preparation Application	34.35±8.50	34 (11-55)	0.880	0.882
Earthquake Preparedness	11.36±2.50	12 (3-15)	0.817	0.821
Sustainability Earthquake Awareness	59.64±10.03	60 (22-90)	0.839	0.853
Self-Efficacy	2.65±0.72	2.64 (1-5)	0.881	0.892

As shown in Table 6, Cronbach's Alpha and McDonald's Omega values are very close for all subscales and scales. This indicates that the scales have strong internal consistency and that the results are robustly validated against normality assumption violations, not solely dependent on Alpha. Omega values above 0.75 support the reliability of the measurements.

4.4. Research Model Test

An analysis based on the multivariate normality criterion demonstrated that the data exhibited a normal distribution (critical value = 9.633). Therefore,

the Maximum Likelihood estimation technique was selected for the analyses (Gürbüz, 2024). When the model fit values were examined; GFI=1, CFI=1, IFI=1 and SRMR=0. The path coefficient between earthquake knowledge level and individual self-efficacy score was statistically significant ($p<0.001$). A one unit increase in the earthquake knowledge level score leads to a 0.035 unit decrease in the individual self-efficacy score. Therefore, hypothesis H2: "Earthquake knowledge level has an effect on individual self-efficacy" was supported. This finding shows that knowledge alone is insufficient for self-efficacy, and in some cases, it may even have the opposite effect. That is, individuals who have more knowledge about earthquakes can more clearly see the seriousness of the earthquake risk, their own shortcomings or inadequacies in earthquake preparedness. This leads to a decrease in self-efficacy perception. In addition, having detailed information about earthquakes can often increase feelings of fear and anxiety in individuals living in earthquake-prone areas. These increased emotions weaken individuals' belief in their ability to manage the situation they are in. Individuals with a high level of earthquake knowledge may have sufficient theoretical knowledge, but if they have deficiencies in practical applications (drills, emergency plan preparation, etc.), this leads to low levels of self-efficacy. The path coefficient between individual self-efficacy and sustainable earthquake awareness score was statistically significant ($p<0.001$). A one unit increase in individual self-efficacy score leads to a 4.267 unit decrease in sustainable earthquake awareness score. Therefore, the hypothesis H3: Individual self-efficacy has an effect on sustainable earthquake awareness" was supported. This finding shows that self-efficacy does not always positively correlate with mindfulness; sometimes it can reduce mindfulness and attention levels due to overconfidence. In other words, high self-efficacy can sometimes create a sense of overconfidence in individuals. The fact that individuals are always in a state of readiness makes the need to be aware of the risk they are in and to follow up-to-date information secondary. This prevents awareness from being maintained in a sustainable manner. However, sustainable awareness requires not only knowledge but also staying up-to-date and being open to new developments. The path coefficient between individual self-efficacy and sustainable earthquake awareness score was statistically significant ($p<0.001$). A one unit increase in individual self-efficacy score leads to a 4.267 unit decrease in sustainable earthquake awareness score. Therefore, hypothesis H3: Individual self-efficacy has an effect on sustainable earthquake awareness" was supported. This finding shows that self-efficacy does not always positively correlate with awareness; sometimes it can reduce awareness and attention levels due to overconfidence. In other words, high self-efficacy can sometimes create a sense of overconfidence in individuals. The fact that individuals are always in a state of readiness makes the need to be aware of the risk they are in and to follow up-to-date information secondary. This prevents awareness from being maintained in a sustainable way. However, sustainable

awareness requires not only knowledge but also staying up-to-date and being open to new developments. The path coefficient between earthquake knowledge level and sustainable earthquake awareness score was statistically significant ($p<0.001$). A one unit increase in earthquake knowledge level score leads to a 0.386 unit increase in sustainable earthquake awareness score. Therefore, the hypothesis H1: "Earthquake knowledge level has an effect on sustainable earthquake awareness" was supported. This finding shows that as the level of knowledge increases, the level of preparedness and awareness of individuals about earthquakes strengthens. Increasing the level of earthquake knowledge enables individuals to know which precautions to take, how to act in case of danger and what to do after the earthquake. In this way, individuals' awareness levels are strengthened and their level of consciousness about possible processes increases. Sustainable earthquake awareness is not only a temporary knowledge but also involves keeping this knowledge up-to-date and reflecting it on behaviours. Since individuals with high levels of knowledge tend to keep their awareness up to date, the increase in knowledge supports the continuity of sustainable awareness (Table 7).

Table 7. *Model Results*

			β^1	β^2	Std error	p	R^2
ISE	<---	EKL	-0.035	-0.509	0.003	**<0.001**	0.259
SEA	<---	ISE	-4.267	-0.308	0.703	**<0.001**	0.385
SEA	<---	EKL	0.386	0.404	0.051	**<0.001**	

*** β^1: Unstandardized path coefficient; β^2: Standardized path coefficient; %95 CI: %95 Confidence Interval**

The mediating role of individual self-efficacy in the relationship between earthquake knowledge and sustainable earthquake awareness was found statistically significant ($p<0.001$). Therefore, hypothesis H4: "Individual self-efficacy plays a mediating role in the relationship between earthquake knowledge and sustainable earthquake awareness" was supported. This finding reveals that individual self-efficacy acts as a critical bridge between earthquake knowledge and sustainable earthquake awareness and that this psychological factor should be taken into consideration in interventions to increase earthquake awareness. The mediating effect revealed by the research shows that earthquake education and awareness-raising interventions should not be limited to the transfer of information, but should also include support elements that will enable individuals to feel competent. Thus, a sustainable level of awareness can be created by closing the gap between knowledge and behaviour (Table 8). Path Coefficients of the Model are presented in figures 5.

Table 8. *Mediation Model Results*

	β¹ (%95 CI)	β²	p
EKL --> ISE --> SEA	0.149 (0.097-0.214)	0.157	**<0.001**

*** β¹: Unstandardized path coefficient; β²: Standardized path coefficient; %95 CI: %95 Confidence Interval**

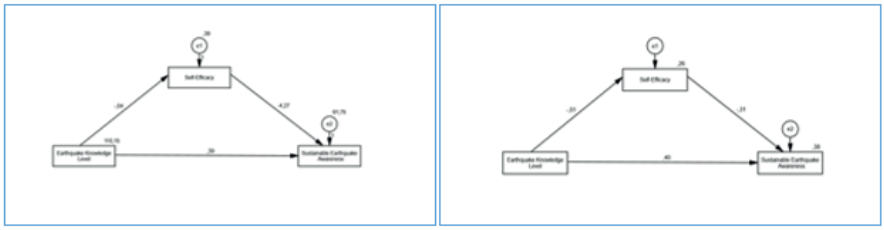


Figure 5. a) *Unstandardized Path Coefficients of the Model. b) Standardized Path Coefficients for the Model*

The results related to the hypotheses developed in line with the aim and scope of the study are presented in Table 9.

Table 9. *Hypotheses and Support Status*

Hypothesis	Hypothesis Statement	Result
H_1	Earthquake knowledge level has an effect on sustainable earthquake awareness.	**Supported**
H_2	Earthquake knowledge level has an effect on individual self-efficacy.	**Supported**
H_3	Individual self-efficacy has an effect on sustainable earthquake awareness.	**Supported**
H_4	Individual self-efficacy plays a mediating role in the relationship between earthquake knowledge level and sustainable earthquake awareness.	**Supported**

5. Discussion and Conclusion

With current technology, it is not possible to predict the location, magnitude and time of an earthquake with certainty. However, with awareness and education, earthquakes can be prevented from becoming disasters or their damages can be reduced. Individuals' level of knowledge about earthquakes directly affects their preparedness and their ability to cope with earthquakes. However, knowledge alone is not sufficient in this process. Individuals' self-efficacy level is a determining factor in the transformation of knowledge into behaviour. Therefore, the aim of the study is to examine the effect of individuals' earthquake knowledge levels on sustainable earthquake awareness in terms of the mediating role of individual self-

efficacy. In this context, the study first examined the effect of earthquake knowledge level on sustainable earthquake awareness. Then, the effect of earthquake knowledge level on individual self-efficacy was analysed. Then, the effect of individual self-efficacy on sustainable earthquake awareness was investigated. Finally, the mediating role of individual self-efficacy in the relationship between earthquake knowledge level and sustainable earthquake awareness was examined. This study offers an original contribution to the literature by proposing a comprehensive framework that simultaneously examines earthquake knowledge level, sustainable earthquake awareness, and individual self-efficacy. In particular, the study fills a gap in previous studies by revealing the mediating role of individual self-efficacy in detail. In this way, it is thought that the study will bring a new perspective to the field of earthquake education.

Quantitative research method was used in the study, and the data were obtained by questionnaire method. A questionnaire form was used as a data collection tool. The questionnaire form was applied to the participants online. 392 valid questionnaires were taken into consideration in the analysis. The survey responses of the participants were analysed through IBM SPSS v23 and IBM AMOS v24 statistical software. Descriptive statistics, normality test, confirmatory factor analysis (CFA), reliability analysis and structural equation modelling were used to analyse the data.

The majority of the participants were male, between the ages of 34-41, married, with a bachelor's degree, earning up to three times the minimum wage and above, and living in the city centre. The Cronbach's Alpha values of the variables analysed in the context of the research are above 0.70, indicating that the scales are highly reliable.

The effect of earthquake knowledge level on sustainable earthquake awareness is clearly seen in the findings of this study. The effect of earthquake knowledge level on sustainable earthquake awareness was analysed, and it was found that this effect is significant and positive. Therefore, the hypothesis H1: "Earthquake knowledge level has an effect on sustainable earthquake awareness" is accepted. This result is in line with the literature (Gür Erdoğan & Şimşek, 2023; Tekin & Dikmenli, 2021; Sözen & Genç, 2023; Turan Bayraktar et al., 2024). The finding obtained shows that the level of knowledge does not only provide a cognitive gain but also contributes to the attainment of a sustainable level of awareness by shaping individuals' attitudes and behaviours towards earthquakes. In other words, as individuals' level of knowledge about earthquakes increases, their tendency to be prepared for possible earthquake scenarios, to assess risks in a healthy way and to develop preventive behaviours in the long term also increases. This reveals the critical role of education and information processes in sustainable earthquake management approaches and offers important implications for practitioners.

When the previous studies are examined, it is seen that the concepts of earthquake knowledge level and sustainable earthquake awareness are discussed together. However, there were no studies examining "the effect of individual self-efficacy on sustainable earthquake awareness" and "the effect of earthquake knowledge level on individual self-efficacy". In addition, no study has been conducted on the mediating role of individual self-efficacy in the relationship between earthquake knowledge level and sustainable earthquake awareness. In this sense, this original research will make important contributions to the related field in terms of filling this gap by conducting studies that are lacking in the literature. In this context, the effect of earthquake knowledge level on individual self-efficacy was investigated, and it was found that this effect was significant and negative. Therefore, the hypothesis H2: "Earthquake knowledge level has an effect on individual self-efficacy." is accepted. This finding indicates that as the level of knowledge about earthquakes increases, individuals become more aware of the risks they may encounter, which may negatively affect their self-efficacy perceptions in the event of a possible earthquake. In other words, an increase in the level of knowledge increases individuals' risk perceptions, which may lead to a decrease in self-efficacy perception. The obtained result makes an important contribution to the literature by revealing that increased knowledge does not increase self-efficacy in all cases, on the contrary, it may lead individuals to question their coping capacity in some cases.

The effect of individual self-efficacy on sustainable earthquake awareness was investigated, and it was found that this effect was significant and negative. Therefore, the hypothesis H3: "Individual self-efficacy has an effect on sustainable earthquake awareness." is accepted. This finding reveals that individuals' perception of high self-efficacy levels in coping with earthquakes may negatively affect their sustainable awareness levels. In other words, individuals with high self-efficacy perceptions may tend to underestimate and underestimate the earthquake risk, which may prevent the adoption of preventive behaviours and the development of sustainable attitudes towards earthquake awareness in the long run. This result is important in terms of showing that self-efficacy perception may not always produce positive outcomes and overconfidence may have negative effects on earthquake awareness. In this context, in strengthening sustainable earthquake awareness, individuals' self-efficacy perceptions should be properly constructed and supported by a realistic risk perception.

The analyses revealed that the effect of earthquake knowledge level on sustainable earthquake awareness is mediated by individual self-efficacy, and this effect is significant. Therefore, H4: "Individual self-efficacy plays a mediating role in the relationship between earthquake knowledge level and sustainable earthquake awareness." hypothesis is accepted. This result strongly

suggests that individual self-efficacy plays a mediating role in the relationship between earthquake knowledge and sustainable earthquake awareness. This finding reveals that the level of earthquake knowledge alone is not sufficient to increase sustainable awareness; individuals' feeling of self-efficacy plays a critical role in transforming knowledge into behaviour and permanent awareness. This result offers important contributions at both theoretical and practical levels and can be considered as a finding that should be taken into consideration in sustainable earthquake management policies.

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Chapter 3

EMOTIONAL INTELLIGENCE LITERATURE: CONCEPTUAL DEVELOPMENT AND EXAMINATION OF MODELS

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1.Introduction

Emotions, as one of the most fundamental psychological components of human life, directly influence a wide range of areas from the way individuals think to their behaviors, from decision-making processes to interpersonal relationships. For many years, research primarily focused on cognitive intelligence as the key determinant of individual success and performance. However, recent studies have revealed that emotions also play a critical role in both personal and social success. In this context, one of the most important concepts developed is Emotional Intelligence (EI).

EI is commonly described as a person's capacity to recognize, interpret, and regulate both their own emotions and those of others, and to apply this understanding to shape their thoughts and actions (Salovey & Mayer, 1990). This capability supports individuals not only in managing their inner emotional states but also in building balanced, positive, and productive relationships with the people and environment around them. Daniel Goleman highlighted the crucial role of EI in determining life success, arguing that cognitive intelligence by itself cannot fully account for an individual's overall accomplishments (Goleman, 1995, 1998, 2003).

To fully understand the concept of EI, it is necessary first to examine the notions of "emotion" and "intelligence" separately. The word emotion is derived from the Latin term emovere, meaning "to move or stir up." This etymology reflects the role of emotions as fundamental psychological processes that drive human behavior. Emotions allow individuals to respond quickly, often automatically, to events in their environment through biological and psychological mechanisms (Schulz & Magistretti, 2012). In this process, the brain sends signals through emotions to other organs, guiding how to react in certain situations. For instance, the emotion of fear in a dangerous situation can trigger escape or defensive behaviors. Thus, emotions serve not only a biological function that supports survival but also a guiding role in social interactions.

Neuroscience research has shown that emotions are connected to evolutionarily older regions of the human brain. Structures such as the limbic system and amygdala play a central role in the rapid perception of emotions and the generation of effective responses. This indicates that emotions have not only psychological but also biological and evolutionary foundations (LeDoux, 1996; Schulz & Magistretti, 2012). These fundamental functions of emotions enable individuals both to react to environmental threats and to organize complex behaviors such as social adaptation and cooperation.

The concept of intelligence, derived from the Latin intelligentia, refers to the ability to perceive, understand, grasp, and solve problems. The human brain, particularly the neocortex, enables higher-level cognitive

processes such as strategic thinking, planning, reasoning, and abstract comprehension (Hawkins et al., 2019; Szafranski, 1997). Therefore, for many years, intelligence was primarily associated with cognitive processes and was mostly measured through IQ tests. However, it became increasingly recognized that human behavior cannot be explained solely by cognitive intelligence, and the impact of emotional factors on success began to receive greater attention.

The conceptual foundations of EI can be traced back to Edward Thorndike's (1920) idea of social intelligence, which he defined as the capacity to understand others and navigate social interactions effectively. This perspective was later reinforced by Howard Gardner's (1983) theory of multiple intelligences, which integrated EI-related concepts through the definitions of interpersonal and intrapersonal intelligence.

The contemporary framework for EI was formally established by Peter Salovey and John D. Mayer (1990), who described it as the ability to monitor, differentiate, and utilize both personal and external emotions to guide cognitive processes and behavior. By 1997, Mayer and Salovey further refined this into a four-branch model: perceiving emotions, facilitating thought with emotions, understanding emotions, and regulating emotions. Together, these components play a vital role in strengthening emotional awareness and enabling individuals to manage their emotional reactions in a deliberate manner (Mayer & Salovey, 1997).

EI became widely recognized after the publication of Daniel Goleman's book Emotional Intelligence in 1995. The book demonstrated that EI is not merely a theoretical idea but also an important factor influencing areas such as professional life, leadership, education, and interpersonal relationships (Goleman, 1995). Following its publication, the concept of EI received increasing attention and started to be widely explored in both academic studies and practical applications.

Today, EI is regarded as a multidimensional concept linked to various areas, from personal development to leadership skills, and from academic achievement to workplace performance. In fields such as education, management, health sciences, and organizational behavior, EI is considered a critical construct for understanding psychological resilience, social adaptation, and professional success (Mayer et al., 2008). Furthermore, the proliferation of digital education and online learning platforms has created new opportunities for measuring and developing EI.

EI is a multidimensional competence that helps individuals understand their own emotions while facilitating effective and harmonious behavior in social contexts. This chapter explores the historical development, theoretical foundations, and prominent models of EI. Additionally, it examines its

applications in education, leadership, and the workplace, highlighting both the theoretical and practical dimensions of the concept.

2. Theoretical Development of the Concept of EI

Although the concept of EI is considered relatively new in modern psychological literature, its foundations are rooted in earlier psychological approaches. The idea that human behavior cannot be explained solely through cognitive intelligence has gained increasing significance, particularly with the recognition of the importance of social relationships and interpersonal interactions. In this context, the emergence of the EI concept is closely linked to previous theoretical approaches, such as social intelligence and multiple intelligences theories.

One of the theoretical roots of EI lies in the concept of social intelligence, introduced by Edward Thorndike in 1920. Thorndike defined social intelligence as the ability of individuals to understand others and behave effectively in social interactions. This approach highlighted that human success cannot be explained solely by academic or cognitive intelligence, emphasizing the importance of social and emotional skills (Thorndike, 1920). Thorndike's perspective later provided a crucial theoretical foundation for the development of the EI concept.

Another important influence on the development of EI emerged from Howard Gardner's theory of multiple intelligences. In his 1983 work, Gardner proposed that intelligence should not be viewed as a single, unified ability but rather as a collection of different forms of intelligence expressed across various domains (Gardner, 1983). Within this framework, interpersonal and intrapersonal intelligence were particularly influential in shaping later understandings of EI. Interpersonal intelligence involves the capacity to recognize and interpret the emotions, intentions, and motivations of others, whereas intrapersonal intelligence refers to the ability to understand and reflect on one's own emotions and inner experiences. These two forms of intelligence later became central elements in many models of EI.

The contemporary concept of EI was first formally articulated by Peter Salovey and John D. Mayer in 1990. They described EI as the ability to observe, differentiate, and make use of both one's own emotions and those of others in order to guide thinking and behavior (Salovey & Mayer, 1990). This definition emphasizes that EI extends beyond simple emotional awareness and includes the effective integration of emotions into cognitive processes and decision-making.

In later work, Salovey and Mayer expanded and structured the concept more clearly by identifying four main abilities: perceiving emotions, using emotions to support thinking, understanding emotions, and regulating

emotions (Mayer & Salovey, 1997). This framework conceptualizes EI as a set of abilities similar to cognitive intelligence, highlighting an individual's capability to process and manage emotional information.

A major milestone in the recognition of EI both in academia and among the general public came with Daniel Goleman's 1995 book, Emotional Intelligence: Why It Can Matter More Than IQ. Goleman's work emphasized the significance of EI in professional life, leadership, education, and interpersonal relationships (Goleman, 1995). Within less than two years of its publication, the book was translated into twenty-one languages and attracted widespread attention. Goleman argued that EI contributes substantially to life success and positively affects both individual and societal well-being. In fact, TIME magazine featured the topic on its October 1995 cover under the headline, "What's Your EQ? Not Your IQ." Goleman's work significantly contributed to discussions on EI not only in academic circles but also in business and educational contexts.

According to Goleman, EI extends beyond the ability to recognize and understand emotions. It also encompasses an individual's capacity for self-motivation, empathy, and effective management of social relationships. This perspective suggests that EI plays a critical role in both social and professional success (Goleman, 1998).

Following Salovey and Mayer's initial study in 1990, research on EI expanded rapidly, with various scholars proposing theoretical models (Goleman, 1995; Bar-On, 1997; Schutte et al., 1998). These models are generally categorized under two main approaches: the ability-based approach and the mixed approach. The ability-based approach conceptualizes EI as a cognitive skill, whereas the mixed approach integrates EI with personality traits, social skills, and motivational factors. These differing perspectives provide valuable insights into understanding the individual and social functions of EI.

Today, EI is widely recognized as an important psychological construct that reflects an individual's ability to recognize, interpret, regulate, and effectively utilize emotional information. In this regard, EI has become a prominent field of study not only within individual psychology but also in various disciplines, including organizational behavior, leadership, education, and health sciences (Mayer et al., 2008).

3. Models of EI

EI has gained significant traction in academic literature, leading researchers to establish various theoretical frameworks for its definition and measurement. These frameworks are typically divided into two primary categories: ability-based models and mixed models. While ability-based models treat EI as a distinct cognitive capability, mixed models integrate it

with personality characteristics, social competencies, and internal drivers (Mayer et al., 2004). Within this field, the most prominent frameworks include the ability-based approach pioneered by John D. Mayer and Peter Salovey, alongside the mixed-model perspectives introduced by Daniel Goleman and Reuven Bar-On.

3.1 Mayer and Salovey's Ability Model of EI

EI as an ability-based construct is defined as an individual's capacity to process, understand, and regulate emotional information, a framework first introduced and later systematically refined by Peter Salovey and John D. Mayer (Salovey & Mayer, 1990; Mayer & Salovey, 1997). While the original model focused on three core pillars, the appraisal, regulation, and utilization of emotions to facilitate thought it eventually evolved into a more sophisticated four-dimensional hierarchy (Mayer et al., 1999). This structure begins with Perceiving Emotions, the fundamental ability to accurately identify emotional cues in oneself and others, and extends to Using Emotions to Facilitate Thinking, where emotions are harnessed to prioritize attention or enhance cognitive tasks like creativity.

The higher-level dimensions of the model include Understanding Emotions, which involves analyzing the relationships between different feelings and their transitions over time, and Managing Emotions, considered the most advanced stage where individuals strategically regulate emotional responses for constructive outcomes rather than mere suppression. Because this approach treats EI as a quantifiable mental aptitude similar to traditional intelligence, it has gained significant academic recognition, particularly through the use of the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) to evaluate performance across these four primary branches (Mayer et al., 2002).

3.2 Goleman's EI Model

EI became a central pillar in non-academic and organizational discourse following Daniel Goleman's assertion that emotional competencies are fundamental to leadership and life success (Goleman, 1995). Classified as a mixed model, this framework extends beyond cognitive ability to include a synergy of personal and social dimensions, specifically: self-awareness, self-regulation, motivation, empathy, and social skills (Goleman, 1998). These components collectively enable individuals to manage their internal states while navigating complex interpersonal dynamics.

The model's prominence in organizational behavior stems from its practical application in professional development and team effectiveness. Empirical evidence suggests that high levels of these emotional competencies correlate strongly with superior leadership performance and overall

organizational health (Boyatzis, Goleman & Rhee, 2000). By integrating these traits into a measurable professional framework, Goleman's model has secured a permanent place in management literature.

3.3 Bar-On's EI Model

EI is further conceptualized through Reuven Bar-On's framework, which defines the construct as a multifaceted array of emotional and social competencies that determine how effectively individuals navigate environmental pressures and stress (Bar-On, 1997). Categorized as a mixed model, this approach integrates cognitive intelligence with personality traits across five key dimensions: intrapersonal skills (self-awareness and self-expression), interpersonal skills (empathy and social responsibility), adaptability (flexibility and problem-solving), stress management (tolerance and impulse control), and general mood (optimism and happiness).

The practical utility of this model is centered on its ability to predict emotional and social functioning in diverse contexts. To operationalize this theory, Bar-On developed the Emotional Quotient Inventory (EQ-i), which remains one of the most statistically validated and widely utilized instruments for assessing emotional intelligence in the literature (Bar-On, 1997). By focusing on "emotional-social intelligence," this model offers a comprehensive view of how emotional health and social skills collectively contribute to an individual's overall resilience and psychological well-being.

3.4 Comparison of EI Models

Comparing EI models is critical not only for understanding conceptual differences but also for making strategic applications in education, workplace, and clinical settings. Ability-based models treat EI as a measurable and developable cognitive ability. In this approach, an individual's skills in perceiving, interpreting, using, and managing emotions can be evaluated using performance criteria, similar to traditional IQ tests. The Mayer and Salovey model, in particular, is widely used in psychometric research and academic studies. Performance-based tests, such as the MSCEIT, allow researchers to examine individuals' emotional information processing capacities objectively, providing a reliable data source for educational psychology, clinical psychology, and neuropsychology research (Mayer et al., 2004). Because this model conceptualizes EI as a set of abilities, it is particularly valuable for identifying areas of strength and weakness and designing targeted development programs.

In contrast, mixed models conceptualize EI as a broader, multidimensional construct. The models developed by Daniel Goleman and Reuven Bar-On encompass not only cognitive abilities but also personality traits, motivation, social skills, stress management capacity, and overall life satisfaction. This approach is especially relevant in organizational behavior, leadership

development, and human resources. For example, a manager may have strong emotion-perception skills but limited empathy and social abilities, which could restrict their capacity to manage team conflicts or boost motivation. Mixed models provide a more comprehensive framework for understanding such multidimensional interactions, designing employee development programs, and optimizing organizational success (Goleman, 1998; Bar-On, 1997).

The differences between ability-based and mixed models are also reflected in their assessment methods. Ability-based approaches emphasize performance-based tasks and objective measurements, whereas mixed models rely on multiple data sources, such as self-report questionnaires, behavioral observations, and social feedback. This distinction offers important advantages for understanding how EI operates both at the individual level and within groups or organizations. Literature suggests that these approaches are complementary; high cognitive-emotional abilities may not translate into life success if social and motivational dimensions are lacking. Therefore, evaluating both models together allows for a comprehensive and holistic understanding of EI (Mayer et al., 2008).

Additionally, the application outcomes of these models across different sectors and domains are noteworthy. In educational settings, ability-based assessments are used to understand students' emotional information processing capacities and develop personalized learning plans, whereas mixed-model approaches are applied to programs designed to enhance motivation, empathy, and social skills. Similarly, in organizational contexts, mixed models provide a broader perspective for assessing managers' and employees' social interactions, stress management abilities, and organizational commitment within leadership and teamwork frameworks. In this regard, EI assessments play a crucial role not only in evaluating individual performance but also in optimizing group dynamics, communication quality, and overall workplace efficiency.

The differences between EI models allow for the development of assessment and development strategies tailored to the needs of individuals and organizations, both theoretically and practically. When used together, the advantages of ability-based and mixed models enable a holistic understanding of EI and support its effective application in both academic and professional contexts.

4. Measurement of EI and Assessment Tools

The quantification of EI is vital for optimizing performance in social, educational, and professional spheres. Assessment methodologies are generally bifurcated into performance-based tests, which objectively gauge one's ability to process emotional data, and self-report questionnaires, which capture subjective perceptions of emotional aptitude. While each approach

offers distinct contextual advantages, their concurrent application ensures a comprehensive and multifaceted evaluation of emotional intelligence.

4.1 SSEIT (Schutte Self-Report EI Test)

The SSEIT, established by Schutte et al. (1998), serves as a self-report instrument grounded in the original emotional intelligence framework proposed by Salovey and Mayer (1990). This psychometric tool enables individuals to evaluate their own emotional competencies through a 33-item scale. It specifically quantifies three core dimensions, emotional awareness, understanding, and management and has gained extensive traction within psychological and educational research due to its practical self-assessment format.

4.2 ECI (Emotional Competence Inventory)

The ECI was developed by Boyatzis et al. (1999, 2000) to assess EI and competencies in the workplace. Two versions of the scale exist: ECI 1 includes four primary dimensions, twenty competencies, and 110 items, while ECI 2 comprises four dimensions, eighteen competencies, and 72 items. These instruments aim to provide a comprehensive assessment of individuals' EI skills and work performance, and they are particularly popular in leadership development programs.

4.3 TEIQue (Trait EI Questionnaire)

The TEIQue, developed by Petrides and Furnham (2001), is a comprehensive self-report questionnaire that conceptualizes EI as a personality trait. It assesses individuals' emotional dispositions, encompassing four core factors, fifteen sub-facets, and 143 items. Its detailed structure makes TEIQue a highly comprehensive measurement tool.

4.4 MSCEIT (Mayer-Salovey-Caruso EI Test)

The MSCEIT, established by Mayer, Salovey, and Caruso (2002), is a performance-based instrument designed to evaluate emotional intelligence through four distinct branches: perceiving, using, understanding, and managing emotions. Consisting of 141 items, this test objectively quantifies an individual's ability to solve emotional problems rather than relying on self-perception. Given its rigorous design, it has become a standard metric in both academic inquiry and clinical assessments.

4.5 WLEIS (Wong and Law EI Scale)

The WLEIS, developed by Wong and Law (2002), is a specialized self-report instrument designed to quantify emotional intelligence within organizational settings. It evaluates four key dimensions: self-emotion appraisal, others' emotion appraisal, use of emotion, and regulation of emotion. Due to its strong psychometric properties and efficiency, the WLEIS is widely utilized in

management and organizational behavior research to analyze the relationship between emotional aptitude and workplace performance.

4.6 GECo (Geneva Emotional Competence Test)

The GECo, developed by Schlegel and Mortillaro (2019), is an online assessment tool designed to evaluate EI skills in workplace and organizational contexts. With 110 items covering four key ability areas, GECo measures individuals' capacities to perceive, use, understand, and manage emotions.

5. The Importance of EI in Education and the Workplace

EI represents the capacity to identify and regulate one's own emotions while accurately perceiving the feelings of others to facilitate effective communication (Salovey & Mayer, 1990). Beyond fostering emotional harmony, this competency sharpens cognitive functions and serves as a vital determinant of success in both educational and professional spheres, where social adaptability, empathy, and stress management are as highly valued as traditional problem-solving (Petrides & Furnham, 2001). Within academic settings, EI optimizes the learning process by bolstering student motivation and self-efficacy; specifically, heightened self-awareness enables students to navigate academic pressures and utilize cognitive resources more efficiently (Bandura, 1986; Salovey & Grewal, 2005). Empirical evidence consistently links high EI with superior outcomes, such as the significant correlation found between nursing students' emotional intelligence and both their GPA and clinical proficiency (Codier & Odell, 2014).

Furthermore, research emphasizes that EI is a cornerstone of psychological resilience and interpersonal effectiveness. Gharetepeh et al. (2015) identified a positive relationship between EI and self-efficacy among university students, while a study by Shengyao et al. (2024) involving 518 Chinese students demonstrated that EI enhances academic achievement and well-being through traits like resilience and intrinsic motivation. In addition to individual benefits, EI strengthens social competencies and collaborative skills, which are essential for group dynamics. Students with advanced emotional intelligence tend to interact more productively in teamwork environments, a claim supported by findings of a positive relationship between EI levels and the successful outcomes of team projects (Nguyen et al., 2022).

In the professional arena, EI is a pivotal determinant of success, underpinning core competencies such as leadership, effective communication, and stress resilience (Goleman, 1995; Bar-On, 1997). Individuals possessing high emotional intelligence navigate workplace tensions more adeptly and demonstrate superior problem-solving capabilities. Empirical evidence consistently supports the link between EI and optimized performance; for instance, Ogińska-Bulik (2005) found that EI significantly mitigates the adverse health effects of workplace stress

among human services employees. Similarly, longitudinal research by Karimi et al. (2020) demonstrated that targeted EI training for healthcare workers led to measurable improvements in job performance, psychological empowerment, and the overall quality of care provided.

Beyond individual performance, EI serves as a catalyst for organizational synergy and adaptation. Mindeguia et al. (2021) highlighted that team-level EI mediates the impact of transformational leadership on employee cohesion, suggesting that managers who skillfully regulate emotional processes foster stronger collaborative bonds. This competency is increasingly vital in the contemporary landscape of digitalization and hybrid work, where EI supports "digital empathy" and conflict resolution within virtual teams (Yasmeen et al., 2024). Ultimately, the emotional skills cultivated during formal education transition into professional leadership and team stability, securing long-term career success and institutional effectiveness (Goleman, 1995; Bar-On, 1997; Boyatzis et al., 1999).

6. Discussion and Conclusion

This chapter has synthesized the complex landscape of EI, tracing its trajectory from early conceptual roots to its critical role in modern society. The collective evidence from literature and empirical studies underscores that EI is far more than an internal regulatory mechanism; it is a multifaceted competency involving the strategic management of social dynamics and environmental stressors (Salovey & Mayer, 1990; Goleman, 1995; Bar-On, 1997). Consequently, EI serves as a cornerstone for both individual achievement and collective institutional success.

In educational environments, EI functions as a vital catalyst for student success by bolstering self-efficacy and resilience (Bandura, 1986; Salovey & Grewal, 2005). As demonstrated by recent research, students with high emotional aptitude navigate academic pressures more efficiently and achieve superior outcomes compared to their peers (Codier & Odell, 2014; Shengyao et al., 2024). Beyond individual grades, the developmental impact of EI on empathy and collaborative skills prepares students for the interpersonal demands of a globalized world (Nguyen et al., 2022).

As individuals transition into the professional arena, these emotional competencies evolve into indispensable leadership and organizational assets. In the workplace, high-EI individuals excel in problem-solving and stress management, fostering a culture of psychological empowerment and well-being (Goleman, 1995; Karimi et al., 2020). The synergy between transformational leadership and team cohesion highlights that EI is not merely an individual trait but a driver of organizational synergy, especially in today's increasingly digitalized and hybrid work models (Mindeguia et al., 2021; Yasmeen et al., 2024).

The conceptual tension between ability-based and mixed models reveals that these frameworks are fundamentally complementary (Mayer et al., 2008). While ability-based models provide the rigor for performance measurement (Mayer & Salovey, 1997), mixed models offer the psychological breadth including motivation and social skills needed for practical growth (Goleman, 1998). Integrating these perspectives allows for a holistic understanding of EI as a lifelong developmental process.

Ultimately, fostering emotional intelligence is a fundamental strategy for sustainable success. The transition from educational awareness to professional effectiveness underscores EI as a core competency for leading a sustainable and impactful life. Future research should prioritize exploring the nuances of EI across digital platforms and diverse cultural contexts, ensuring that the theoretical contributions of the field continue to offer practical solutions for societal well-being.

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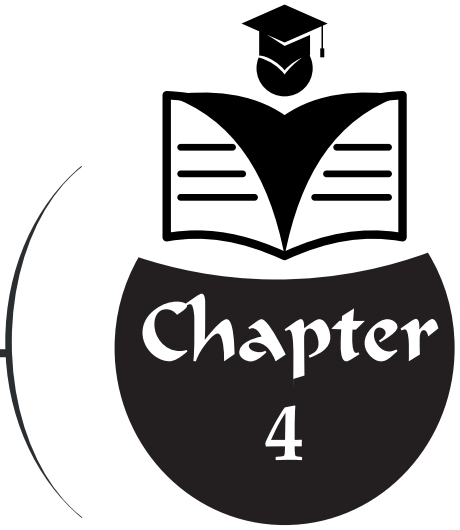

CHILDREN IN THE DIGITAL SHOWCASE: A SOCIOLOGICAL AND PSYCHOLOGICAL PERSPECTIVE ON IDENTITY CONSTRUCTION

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INTRODUCTION

Digitalization is the process of redefining the world and reconstructing all concepts related to life from scratch. In this process, objects and phenomena acquire new forms according to the requirements of the digital world, and their contents are restructured. It has become both a natural consequence of this process and an inevitable necessity of modern daily life that every new content presented is compatible with digitalization. Rather than being a final stage reached by societies and individuals, digitalization refers to a dynamic period in which every social structure and individual personally participates in the development process, produces content, and is included in usage networks. For this reason, every phenomenon and operation within the scope of digitalization should be understood and defined within the framework of its own unique qualities, instead of pre-determined patterns or standard criteria. Consequently, with digitalization, every process and narrative describes a unique field that is open to debate and whose boundaries are being redrawn (Özkeçeci, 2024).

Children are also among the groups whose boundaries are constantly redefined and whose development processes are deeply affected by digitalization. Today, children socialize through various platforms and activities that support interaction, communication, and building connections on the internet. Digital environments offer children extensive opportunities to communicate with their peers, share their experiences, and come together in collaborative projects. This comprehensive socialization process can be classified under several main headings, such as social network usage, online games, content production, and educational interactions (Yılmaz &Aktürk, 2024).

The digital age has led to radical changes in the processes of an individual's identity construction and self-meaning. Although virtual reality and digital platforms offer a continuous communication environment, these interactions have qualitatively become superficial and undergone a loss of meaning, while physical distances have lost their importance. While individuals redefine themselves through digital media, they also find themselves in a position where they must constantly question the reality presented by the digital world. Today, the freedoms provided by existing in the digital world, while on one hand deepening the individual's process of self-meaning, have on the other hand transformed this process into a more layered, contradictory, and complex structure. Although digital identities seemingly offer freedom to individuals, they actually bring along more uncertainty and a constant obligation to redefine oneself. Consequently, identity formation in the digital age can be characterized as part of a constantly renewed and dynamic process nourished by individuals' experiences in the digital world (Sacer, 2024). Within this dynamic process, children also experience the process of identity

construction. Children, who are active users of the digital world from a very young age, engage in an effort to construct their own identities and existences through various platforms. Self-presentation on digital platforms is a highly complex process encompassing the ways children express themselves in online environments, how they try to create an impression on others, and how they showcase their identities. Children's self-presentations in digital media generally exhibit a structure that is entertainment-oriented, enriched with visual and auditory elements, and intertwined with consumption habits. These contents do not only affect the way the child expresses their identity; they also radically shape their cultural, emotional, and social worlds. In this context, the self-presentations displayed by children essentially bear an entertainment-based and play-oriented character (Alkan & Candemir, 2025). Children's ways of constructing and presenting their selves offer an interdisciplinary research area that needs to be meticulously addressed from the perspectives of psychology and sociology. With the current study, children's identity construction process in digital environments will be discussed from psychological and sociological perspectives.

1. Digitalized Society

Digitalization, a prominent phenomenon of the 21st century, has deeply affected the individual and society. Although it appears to be a new concept, the foundations of digitalization are based on the social, political, and economic developments experienced throughout human history. Especially the technological advancements in the Industrial Revolution played a critical role in the formation of this process. Humanity's constant need for development and production necessitated societies to pass through certain industrial stages. Each historical phase prepared the ground for the next, and every step in the industrial field paved the way that made today's digital world possible (Kafkasyalı & Oğuzhan, 2025).

Digitalization is not just a technological innovation; it is a social and cultural process that fundamentally changes the ways information is produced, transmitted, and shared. This process encompasses the transfer of information from physical environments to digital environments and the realization of human activities through digital platforms with each passing day (Kalkan, 2025). Moving from this point, digitalization refers to the process of binary data sequences, formed by 0s and 1s combining in an endless cycle, becoming meaningful (Bozkurt et al., 2021). However, beyond technical definitions, digitalization bears a meaning that places the human being directly at its focus. To see this concept merely as a transition from analog to digital format or as a data process consisting of 0s and 1s is to limit it only to its technical dimension. Yet, digitalization is a comprehensive phenomenon that permeates every area of human life and fundamentally affects social relations beyond a technical transformation. In a more concise expression, digitalization is a

comprehensive transformation process that contains various opportunities and threats for both individuals and societies (Kafkasyalı & Oğuzhan, 2025). As a result of all these transformations, digital society emerges as a structure where power relations are reshaped, objects become more active in human life than ever before, and communication gains new forms. In this society, culture is both universalizing and transforming; there is a risk of digital data being used against individuals; consumption habits are changing with the active participation of the consumer, and the ways people define themselves are directly affected by digital processes (Özuz, 2018).

2. The Digitalizing Generation

Individuals are affected by the characteristic structure of the historical period they are in, as well as the socioeconomic, political, and cultural events experienced. People born in approximately the same years show similar characteristics due to these shared experiences and are classified through the concept of generation based on these similarities (Akduman & Hatipoğlu, 2021). Today, digital tools have become increasingly popular among adults and children because they make life easier, make it more enjoyable, and offer people more time to devote to both themselves and their surroundings. As a result of this situation, the new generation, specifically defined as Generation Z, has adopted the digital world as a way of life. These children, born after 2003 and called Generation Z, follow digital developments very closely and use numerous social media channels extremely effectively, unlike previous generations (Aral, 2022). Generations X and Y, which existed before Generation Z, also bear the characteristics of their periods. Generation X, covering individuals born between 1965 and 1979, is known for being sensitive to social issues, resilient, and having a global perspective. The most fundamental feature that distinguishes Generation Y, covering individuals born between 1980 and 1999, from other generations is their strong commitment to technology. Members of this generation lead a life intertwined with technology both in their professional and social lives (Akgül, 2022). Generation Z, which follows Generation Y, shows a high level of adaptation to technology and carries it like a limb, as they were born into the existing technological acceptance.

New generation names have been added to the literature based on the degree of predisposition and proximity to technology use. Prensky (2001) states that the advancements in digital technologies over the last decade have created various differences between generations. He defined this new generation, who communicates almost in a digital language through the internet, virtual games, and smartphones, as "digital natives" (Generations Y and Z). In contrast, he used the expression "digital immigrants" (Generation X) for the older generation born before 1980, who feel more like strangers to this world compared to subsequent generations regarding digital technologies (Karabulut, 2015). Digital natives use digital spaces with extreme competence,

learn through games, and create a unique new communication language; due to their constant consumption of digital media, their brain structures also develop in accordance with this lifestyle. On the other hand, digital immigrants prefer more traditional and manual methods and cannot achieve as fast and complete an adaptation to the digital world as the natives (Tombul, 2020). The generation born between 1970 and 2000, carrying the characteristics of both digital natives and immigrants, is called "digital hybrids." While digital hybrids show similarities to both digital natives and digital immigrants in terms of characteristics, they diverge from them in certain aspects. Although they benefit from all available digital possibilities, they cannot use these tools as competently and effectively as digital natives. For them, traditional concepts still retain their meaning and are found to be more sincere. However, they are not as resistant as digital immigrants regarding adaptation to technology (Karabulut, 2015).

The concept of childhood shaped in today's digital world evokes a structure that is more materialistic, detached from emotional bonds (yet emotion-oriented in games), and harsher, completely different from the perception of the child in traditional society. The child, who begins to acquire their first information from digital media, may at some point have difficulty forming bonds with school, friends, or teachers. The main reason for this is that the brain becomes accustomed to the high passion, increasing adrenaline, and the colorful, fast flow offered by the digital world, constantly desiring them. Furthermore, the competitive social order brought by digitalization causes children to question the system they are in by shaking their existing value judgments (Pembecioğlu, 2021). Although digital tools are an indispensable part of life today, they should be used carefully and diligently, especially considering the developmental processes of children in early childhood. While the digital world offers significant opportunities, incorrect use can transform this situation into a threat. The fact that children are introduced to these tools shortly after birth further increases the magnitude of the threat in question (Aral, 2022). For this reason, families should make plans appropriate for the children's age, health status, character, and developmental level. Efforts should be made to ensure that children benefit in the best way possible from basic requirements such as balanced nutrition, quality sleep, sufficient physical activity, and positive social relations for healthy growth. Parents should be aware that their own technology use can also create negative effects on their children. It should not be forgotten that if parents do not have time to actively play games with the child, it is a critical factor for the child to spend time with another adult or a peer (Mustafaoğlu et al., 2017).

3. Digitalizing Identity and Self

3.1 Psychological Perspective

The placement of digital technologies at the center of daily life has also significantly transformed the childhood experience. Today, children have become not only individuals who consume digital content but also actors who gain visibility, are watched, and are evaluated on various platforms. Especially through social media, video-sharing platforms, and parental shares, childhood is increasingly coming under the influence of digitalization. Interacting with digital technologies has now become a part of the childhood life of many young children (Edwards et al., 2020). This situation suggests that the child's self-perception and identity development are now shaped in relationship not only with the family, school, and peer environment but also with the digital audience and platform dynamics. According to Livingstone and Helsper (2008), children starting to access digital environments at earlier ages is becoming an increasingly common situation; this development, in turn, significantly affects both their social learning processes and their identity formations. According to Buckingham (2019), digital platforms are not only environments that offer entertainment for children; they also function as mediums that support learning, allow for the expression of creativity, and facilitate peer interaction. In this section, the effects of digitalization on the child's identity construction and self-development will be addressed from a psychological perspective.

3.1.1 Psychological Foundations of Self and Identity Development

One of the first systematic explanations regarding the concept of self in psychology was made by William James. According to James, the self, in its most comprehensive sense, expresses the sum total of everything that the individual considers to belong to themselves and can call "mine" (James, 1963). The concept of self is a multidimensional structure containing the individual's information about themselves, the aspects of others' evaluations of them reflected to the individual, and the person's self-evaluations regarding themselves. In this process, feedback received from the environment and the individual's observations regarding themselves are decisive; the person can internalize recurring characterizations about themselves as a part of their self and often regulates their behaviors in accordance with this perception of self (Cüceloğlu, 1997). In the APA dictionary of psychology, identity is defined as the perception of self shaped in line with the individual's social roles and relationships; besides this, it is also emphasized that identity is nourished by the individual's beliefs regarding their self (VandenBos, 2015). Therefore, identity can be seen as related to the cognitive and emotional structures regarding the self gaining an organized, consistent, and continuous integrity over time.

Gains acquired through social experiences and individual experiences play an important role in the formation of the self. Various experiences encountered by the individual from the childhood period onwards shape self-development from different aspects. The child begins to know and make sense of themselves over time through the interactions they establish with their environment. In this direction, how self-development occurs and by which dynamics it is shaped has been handled within the framework of different theoretical approaches in the field of psychology. The aforementioned approaches reveal that the self is not only an individual internal structure; but at the same time, it is a multidimensional structure shaped together with the social environment, interpersonal relationships, and developmental experiences. For this reason, in order to be able to explain self-development more comprehensively, the examination of prominent theoretical views regarding the subject carries importance. In the psychology literature, theorists such as William James, George Herbert Mead, Sigmund Freud, Carl Gustav Jung, Alfred Adler, Gordon Allport, and Eric Berne have presented important theoretical contributions regarding the concept of self and self-development. However, in line with the scope of this section, self-development will be handled within the framework of the approaches of Cooley, Sullivan, Rogers, and Horney.

Charles H. Cooley's Looking-Glass Self Theory: According to Cooley's "Looking-Glass Self Theory," a human does not possess an inherently developed self-perception; by using society as a mirror, they learn things about themselves from others (Taylor et al., 2010). According to Cooley's theory, the child's personality is shaped by the influence of the social context they are in, primarily the family and peer environment. In this approach, the emphasis is directed toward the child evaluating themselves in line with the reactions they receive from their environment to their behaviors, rather than innate drives or genetic tendencies. Within this framework, the concept of the looking-glass self expresses the process of the child trying to understand how the behaviors they exhibit are perceived by others and evaluating these behaviors in a positive or negative way according to the feedback they receive.

Harry Stack Sullivan's Interpersonal Relations Theory: Sullivan developed a dynamic self-psychology that places interpersonal relations at the center. He handled the self as a whole of reflected appraisals formed through how the individual is approved and recognized by others, or conversely, devalued and ignored. According to Sullivan, one of the basic functions of the self-system is to show a defensive functioning aimed at protecting the individual's self-esteem and self-worth from threats. Sullivan named these defensive processes "security operations" (Cortina, 2020). Sullivan focused particularly on how self-development is shaped within the context of interpersonal relations during the early childhood period. According to

Sullivan, who is evaluated within social psychological approaches, the self is not a structure that emerges independently and spontaneously from the individual; it is a formation that develops within social interactions. Sullivan also asserted that the self-system is shaped as an adaptation and protection mechanism developed against the anxiety emerging in interpersonal relations. Within this framework, one of the basic motives behind the individual's behaviors is the need for help and security that they constantly try to cope with. The self-system, on the other hand, is shaped especially under parental influence; it functions toward meeting the individual's needs and maintaining their security (Cevher and Buluş, 2007).

Karen Horney's Sociocultural Personality Theory: Karen Horney asserted that humans are primarily motivated by the desire for self-realization. Horney (1950) analyzed neurosis in an extremely comprehensive manner as a process of alienation from the self due to emotional anxiety. According to her, neurosis is the state of pursuing an idealized self at the expense of the real self.

In Horney's (1950) approach, the primary factor determining child behaviors is the need for emotional security, rather than sexual or destructive drives. The child usually acquires this sense of security through warm and supportive family relationships. In contrast, experiences such as indifference, favoritism, inconsistency, or being mocked can create emotional insecurity by damaging the child's feeling of being sufficiently loved and protected. Horney explained this experience with the concept of basic anxiety and defined it as the individual feeling alone and helpless in an environment where they perceive the world as potentially threatening (p. 18). Horney (1950) asserts that children under the influence of basic anxiety develop unconscious coping patterns to regulate this anxiety. These patterns can be shaped in the form of compliance, aggression, or withdrawal, depending on individual characteristics and environmental conditions. The orientations in question function to respond to the child's needs for security, acceptance, and protection. However, over time, the child may internalize the belief that their own natural existence is insufficient in meeting the needs for love and attention; this directs them toward creating an idealized self-design. Thus, a structural division develops between the individual's real self and the ideal self they want to be or present to others.

Carl Rogers's Person-Centered Theory: In Rogers's approach, the concept of self is handled in two basic dimensions: the real self and the ideal self. While the real self expresses how the individual perceives and evaluates themselves in their current state; the ideal self reflects the self-design that the person desires to reach or wants to be. According to Rogers, the individual's development of self-confidence is also closely related to the form of acceptance they receive. In this context, unconditional positive regard means the person being seen as valuable without being dependent on any condition and being

able to accept themselves as they are; whereas conditional positive regard expresses the situation of the individual receiving approval and support only to the extent that they meet certain expectations. Therefore, this theoretical framework reveals that the individual's self-perception and self-confidence can be shaped depending on the quality of the acceptance they receive from their environment (Kuncoro & Kurniawan, 2024).

3.1.2 Self-Presentation of Children in Digital Environments

Today, digital platforms have significantly transformed the ways individuals express themselves, interact with others, and become visible. In this context, the answer given to the question "Who am I?" is no longer related only to offline experiences, but also to online modes of existence. An individual's representation, interactions, and ways of presenting themselves in digital environments constitute a part of their digital identity. In its most general sense, digital identity expresses how the individual appears, how they are defined, and how they are perceived in the online environment. This identity can sometimes overlap significantly with the offline identity, sometimes differentiate from it, and sometimes display a more flexible appearance between the two structures. Furthermore, digital identity, like offline identity (Roccas & Brewer, 2002), is a structure built within social interactions and possesses multidimensional characteristics (Ellis, 2020; Fieseler et al., 2015). When this framework is evaluated in terms of children, the issue of digital identity becomes even more remarkable. Because children participate in digital environments during a period when the processes of self and identity formation developmentally continue; they present themselves not only within the family, school, and peer environment, but also through social media, gaming platforms, video content, and other digital mediums. In digital environments, children make themselves visible through photographs, videos, profile arrangements, virtual games, shares, and forms of interaction, and they make choices regarding which aspects they want to be recognized for. In this process, peer feedback, likes, and comments become important elements shaping children's self-presentations. In other words, the child does not only show themselves; at the same time, they re-evaluate themselves through the feedback they receive. Children may sometimes highlight certain aspects of their selves while leaving some aspects in the background for the purpose of receiving more acceptance, being liked, or attracting attention. This situation may create a distinction between the real self and the presented self, as well as prepare the ground for the development of a self-perception sensitive to external approval. Therefore, digital self-presentation can be evaluated not only as self-expression, but also as a psychosocial process intertwined with self-development, identity construction, the search for social approval, and the need for belonging.

3.1.3 Psychological Risks in Terms of Identity Development

Digitalization, which is the fundamental reality of modern society, has taken under its influence many areas from human relations to institutional networks. Family relations and the development of the child are also significantly affected by digital tools (Milenkova and Manov, 2020; Rosengren, 2014). "Attachment," which is one of the basic psychological needs of children, involves relationships that provide them with confidence, offer emotional closeness, and function as a "safe haven" in times of need (Bowlby, 1969). In today's digitalizing world, this need for attachment is not limited only to face-to-face human relations, but can also be reflected onto non-human entities such as media characters, artificial intelligence, and robots (Bond & Calvert, 2014; Hoffman, Owen, & Calvert, 2021). Within these virtual experiences, children establish parasocial relationships with the characters they love; they bond emotionally with their stories, laugh with them, and can feel sad for them. In this respect, characters function in the children's world not only as figures being watched, but also as social partners (Richert, Robb, & Smith, 2011). Trustworthy smart digital entities that children bond with can create a very powerful effect on children when they interact as if they are talking to them and provide appropriate and accurate information (Calvert, 2021). Considering this powerful effect, it can be said that digital entities can play an important role in children's processes of self-perception and identity construction. However, if this effect is not limited and directed in a way that considers the benefit of the child, digitalization may lead to various risks and negative consequences in terms of children's emotional, social, and cognitive developments. The negative effects of digital tools on children may differentiate depending on variables such as the child's age and developmental characteristics, the frequency and duration of use, the quality of the content exposed to, and to what extent the child can participate in real-life experiences that support their developmental areas. Nevertheless, the risks digitalization harbors for children in terms of identity development are explained below:

Digital Social Influence and the Search for Approval: With digitalization transforming social life, children's needs for social acceptance, belonging, and approval are also being reshaped through online interactions; this process produces significant consequences in terms of self-presentation and identity development. Friendships established through social media and digital games have led to children moving away from traditional face-to-face interactions. Studies show that virtual environments gaining a central place in social life transforms children's processes of social integration, their participation in group dynamics, and the development of the sense of belonging. In this context, dynamics such as social acceptance, exclusion, and cyberbullying make identity development more complex and weaken the sense of social belonging (Evren, 2025). As children progress within the complex structure

of the online world, they may begin to model their behaviors according to influencers; they may adopt their views, clothing preferences, and even their ethical stances. This situation may lead children to prioritize adapting to online trends instead of developing their own identities and to the weakening of their sense of self (Khatout et al., 2025).

Parent-Child Interaction: Since the foundations of identity development are laid during childhood through relationships within the family, the transformation of parent-child interaction by digitalization constitutes a risk area that needs to be handled carefully in terms of children's self and identity development. Transformations experienced in family life in the digital age significantly affect the forms of communication established with children and parenting approaches. How families manage technology use plays an important role in the quality of children's emotional attachment, character development, and psychological well-being. This shift from face-to-face communication toward digital platforms presents new difficulties in terms of protecting family values, maintaining emotional security, and supporting children's socio-emotional skills (Evendi et al., 2025). Parents being constantly online has led to technology-based forms of communication increasingly taking the place of face-to-face interactions (McDaniel, 2019; Stern & Messer, 2009). This situation also affects daily interactions within the family. Since parents are occupied with digital media for personal and work-related reasons throughout the day, they may use smart devices even during interaction with their children; for example, they may exchange messages while playing with their children (Beamish, Fisher, & Rowe, 2019; Livingstone and Blum-Ross, 2020). The involvement of digital media devices during moments of interaction such as meals, play, and pre-sleep, when quality time is experienced within the family, can lead to parental attention shifting from the child's needs to the device. This situation, in turn, can negatively affect children's socio-emotional development (McDaniel & Radesky, 2018).

Gender Role and Body Image: Since gender roles and perceptions regarding the body hold an important place in children's identity development, content encountered in the digital environment can have an effect that is both guiding and risk-generating for this developmental area. Today, children encounter numerous contents in online environments such as social media, video games, digital advertisements, and the like. These contents sometimes repeat traditional patterns regarding male and female roles, and sometimes present these roles in different and changing forms (Eichen et al., 2021). Research shows that digital media has a significant impact on the development of children's gender identity. Children learn behaviors related to gender especially by watching and imitating the individuals they observe in the media. Researchers emphasize that children receive messages regarding gender from their families; however, these messages can sometimes be

supported and sometimes weakened by the digital content they encounter (Adejumo, 2025; Stockard, 2006). Digital media platforms expose children to different and more diverse representations regarding gender. This diversity can increase differences of opinion among family members, preparing the ground for tension and conflicts in family relationships.

These digital representations regarding gender affect not only children's perceptions of masculinity and femininity roles but also how they evaluate their own bodies and what kind of relationship they establish with their bodies. Body image, which begins to develop in the early childhood period, is the person's subjective representation of their own body and can be evaluated as a multidimensional concept used to define the individual's perceptions, feelings, thoughts, and behaviors regarding their body (Lin & Latoschik, 2022; Marougkas et al., 2023). Beliefs regarding body perception, sensitivities about weight, and attitudes and behaviors aimed at improving physical appearance can begin to be shaped as early as the childhood years. A person's evaluations regarding their body often do not rely solely on physical reality; social environmental factors such as family, peer relationships, and social media play an important role in the shaping of this perception. According to the study by Valkenburg and colleagues (2022), children who frequently interact with influencer content are more likely to experience anxiety regarding their appearance and social status. The study shows that the curated and often exaggerated lives presented by influencers can create unrealistic expectations, which can lead to feelings of inadequacy and stress. In their study, Digennaro and Visocchi (2024) reveal the importance of supporting a positive body image from the early childhood period onwards. In order to reduce the negative effects that social media can create on children and youth, resilience against external factors that threaten healthy body image development must be strengthened from early ages. Therefore, it is important to develop a protective approach that provides the knowledge, skills, and psychological resilience that will support young individuals in acting more consciously in the digital environment and developing a positive body perception (Sun et al., 2022). In summary, since gender and body representations in digital media carry the power to shape children's self-perception, they emerge as an area of influence that must be carefully evaluated for healthy identity development.

3.2. Sociological Perspective

Identity is the state of self-consciousness, which is based on an individual's thoughts about themselves and includes an essential process of awareness, projected onto the outer world. Humans, who are in a state of continuous emotional and mental development, can only actualize themselves through a process that continues over time. The identities of individuals are shaped by the value judgments, lifestyle, political and economic structures of the society they live in, as well as cultural accumulations from the past. This

phenomenon, which spans the entirety of life, has transformed in today's accelerating social life into a more fragmented structure consisting of short-term pieces and the coming together of "moments" instead of long-term and cumulative definitions (Yavuz & Özkeçeci, 2024). Social identities are shaped by social categories we are part of, such as age, gender, culture, or the communities of which we are members. Individual identities, on the other hand, encompass unique attributes such as a person's physical characteristics, appearance, character structure, values, and attitudes. Social identities play a decisive role in our patterns of behavior in social situations. Since we generally tend to shape our behaviors according to the norms of the social groups we belong to, our social identities are more dominant and visible compared to our individual identities (Boz, 2012).

Technological advancements have led to radical changes in individuals' private and social lives, cultures, attitudes, and behaviors. In the recent past, when technology was not yet this widespread, identities were constructed by being influenced by events and phenomena in the social environment in which the individual was directly involved, starting from the family. These identities, shaped by face-to-face interactions in real life, were more transparent and distinct; individuals generally appeared as they were in social life. However today, the process of identity construction has expanded to encompass digital identities created on digital platforms in addition to identities in the physical world (Yavuz & Özkeçeci, 2024). Digital identity encompasses a broad set of elements ranging from personal information to shared thoughts, opinions, and attitudes, shaped as a result of an individual's interactions on online platforms. This structure, which can also reflect the individual's cultural accumulation, is considered a form of identity consisting of all the traces and records left by individuals in digital media. Digital identity can be defined as the subject's personality or persona in the online world. In other words, digital identity refers to the social mask that individuals display in the internet environment and the identities they choose to project to the outside world (Kavut, 2020). Children also use digital platforms to express themselves, sometimes to appear as they are and sometimes as they wish to be, and to exist sometimes with a mask and sometimes without one. This occurs within such a fluid process that children remain mere spectators to the formation of their own digital identities. Suddenly becoming the object of a life in which they are the subject brings along a painful transformation. Children, who are just beginning to internalize the rules of existing within society, exert extra effort to learn how to exist within another world. Perhaps the only positive aspect of the matter is that children are voluntary in this effort. Being natives of the world they were born into facilitates the digital identity formation they carry out, whether consciously or unconsciously.

Sonia Livingstone defines the online world as a private space where children construct, experiment with, and display their own identities within a social framework by interacting with their peers without adult supervision. For children, how they express themselves and how they present themselves to others is of great importance. Today, social media has become the most fundamental tool of this process. Being present on online platforms and sharing content has become an inevitable part of creating an identity, determining a lifestyle, and conducting social relations (Ardıç Çobaner, 2018). Children's self-presentations in digital media generally exhibit a structure that is entertainment-oriented, enriched with visual and auditory elements, and blended with consumption habits. These contents do not only determine the child's way of expressing their identity; they also radically shape their cultural, emotional, and social worlds (Alkan & Candemir, 2025).

3.2.1 Erving Goffman

In the literature, the subject of self-presentation is primarily addressed through the conceptual framework presented by Erving Goffman in his 1959 work titled "The Presentation of Self in Everyday Life." In his work, Goffman argues that individuals control others' perceptions of them. According to this view, individuals constantly perform a performance in daily life in line with social norms, expectations, and cultural values. Goffman uses the theater metaphor to explain this situation. Individuals are actors, and society is the audience. The "front stage" represents the area where the actor displays their carefully constructed self, while the "backstage" represents the area where the actor prepares for the performance and their real self emerges (Serttaş, 2023). When we transfer Goffman's view to daily life; in online environments where public and private spheres are intertwined, we can choose the medium we are in and transform the conditions of that medium according to ourselves. However, the digital environment shapes our self-presentation and draws boundaries for it. The front stage, consisting of our digital self, never fully coincides with our actual state in front of the screen. For example, our digital identities in an internet branch of a bank and in a chat room are quite different from each other. This situation suggests that rather than using different versions of the same identity, we produce different identities in every context (Boz, 2012).

When children create a profile on a social networking site, their self-presentations are shaped within the framework of certain standards and patterns. This created profile reproduces the child's identity within a defined social context and specific formats. Based on Goffman's analysis, it can be said that social conditions and peer groups demand certain behavioral patterns, while technological systems enable the mutual sharing of identity within these standards. Furthermore, these systems create the necessary technical infrastructure for the construction of digital identity and its presentation to others (Boz, 2012).

3.2.2 George Herbert Mead

Representatives of traditional behaviorism defined the concept of self on the basis of conditioned and learned actions exhibited toward the outside world. Objecting to this view, Mead developed the perspective of "social behaviorism," arguing that an individual's behaviors are shaped by society. According to Mead's approach, a person exhibits a conscious will by taking their own experiences and trials into account while performing an action. Through social processes, the individual transforms from a biological entity into a being possessing a mind and a self. Internalizing the social process, the individual acquires the ability to live in a shared world. The individual, who assumes a role within social action, gains the power to transform society by also influencing and regulating the roles of others participating in the same action. In this way, the social self makes the person ready to exhibit creative and moral actions on a social level (Çırak, 2024). In other words, Mead argues that the human self is a product of social processes. Since an individual cannot gain a self without being part of a society, social interactions play a mediating role in the formation of the self. A sense of self does not develop in an isolated individual who does not establish relationships with other people; this sense is shaped only through relationships established with others and positions the person within society. At the same time, the human being, with this capacity of self they possess, also contributes to the shaping of social processes themselves (Yikebali, 2018).

Mead is among the pioneers of symbolic interactionism and believes that the individual expresses themselves through symbols. Today, digital games contain many symbols and signs. Digital games allow for the emergence of new game genres and types of players. In this process, while the social interaction structure of the game is transformed, new forms of socialization develop. Depending on the content of the game, new types of interaction and relationships are established, and accordingly, new bonds of meaning are formed. Furthermore, these communities bring together the interaction between the physical environment and the digital environment. In this process, the design and representation of identity also undergo change; interactions now take place through fictional identities (Boyalı & Aktaş, 2023). Since play is at the center of children's worlds, digital games host their identity construction process on digital platforms. While existing in the game, children keep pace with the fictional world of digitality and say hello to a new self. Symbols transform into the child's language and accompany them in the process of self-expression. In this sense, Mead has made the meaning of the symbols that children use in the process of identity formation in digital environments valuable.

CONCLUSION

Today, digitalization has become the name of a radical transformation far beyond mere digitization. It is not possible to handle this transformation as one-dimensional or to think that only a certain segment of society is affected. So much so that all disciplines concerning humans are creating sub-branches today by taking the "digital" prefix, striving to understand human beings and their relationships. Likewise, the impossibility of fitting the digital into a specific age range is noticed when looking at the impact and scope of digitalization. Digital platforms, into which everyone living is drawn, are most effective on children. Because they, as the natives of this world, adopt and internalize its spaces; they align with it and take the same steps. Although children see the digital as a companion to their pleasant moments, this union sometimes yields desired and sometimes undesired results. The most striking of these results are the emerging digital identities and the phenomenon of the self, which has gained a new form.

Psychological science says that the issue of digital identity is gaining an increasingly critical dimension because children manifest themselves in the digital world during a period when their developmental processes of self and identity formation continue. Children make conscious choices about how they want to be recognized by making themselves visible through photos, videos, and profile arrangements shared on platforms such as social media, gaming platforms, and video content, in addition to family, school, and peer circles. In this process, peer feedback, likes, and comments become the fundamental elements shaping the child's presentation of self, and the child constantly re-evaluates themselves through these reactions. Highlighting certain aspects of their self while hiding others for the purpose of gaining more acceptance or drawing attention may create a distinction between the real self and the presented digital identity, as well as pave the way for the development of a self-perception that is overly sensitive to external approval. Therefore, digital self-presentation is not just a form of self-expression; it is a complex psychosocial process intertwined with identity construction, the search for social approval, and the need for belonging.

Sociological science says that children use digital platforms to reflect themselves sometimes as they are and sometimes as they imagine themselves to be, and to exist with or without masks. This process proceeds so rapidly and fluidly that children, while being the subjects in the construction of their own digital identities, can suddenly become the objects of this process and experience a painful transformation. Children, who are just internalizing the rules of existence within society, also put in an extra effort to exist within another world. Perhaps the only positive side of this is that children are voluntary in this endeavor. Being natives of the world they were born into makes the process of digital identity formation-whether carried out consciously or unconsciously-more natural and easier for them.

For both disciplines, it is a natural situation for the child to be on digital platforms. Therefore, without denying that the reality of this age is digitalization and without rowing against the current, adapting is a prerequisite for reaching children. For the digital to be healthily integrated into the child's world, we must understand the child, see their needs, and make them visible in both traditional and digital environments. As the child is understood, they will feel safe and accept themselves as they are. Thus, regardless of the platform or the people they are with, they will exist with their own identity and perform their self-transference as they feel, rather than through the anxiety of being liked.

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Chapter 5

SPATIAL REPRESENTATIONS OF THE FAMILY IN THE PRODUCTION OF BIOPOLITICAL SOCIETY: THE HANDMAID'S TALE

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The family, in an era where the public-private distinction has become more pronounced alongside modernity, is presented as a representation of the private sphere but is in fact a micro-level regulatory space where power operates most intensely. This regulation is maintained both through discourse and norms, and through the social organisation of roles and the disciplining of bodily relations. As Foucault (1977) states, modern power 'makes bodies obedient and souls productive' (p. 136); this transforms the family into a biopolitical sphere of governance. According to Althusser (1971), the family is where individuals are first called upon to embrace ideology; thus, the subject voluntarily participates in the reproduction of the dominant order. Similarly, Donzelot (1979) emphasises that the modern state positions the family as the fundamental unit of social order and individual discipline. Within this framework, modern forms of social organisation define the family as an ideological form that ensures the continuity of power and enables the reproduction of social order.

This study aims to examine how the institution of the family is transformed into an ideological order through space in modern society. In this context, the study is structured around the following questions:

1. How is the family transformed by biopolitical power?

2. How do social roles function as ideological tools spatially? How are they formally shaped and how do they gain presence in space?

3. What are the forms of compromise and discord that emerge in the biopolitical regulation of the family, and how do these forms redefine social structure?

The questions of the study are examined through an analysis of the television series The Handmaid's Tale (Miller, 2017), which is an artistic production. The series was selected because it represents how the institution of the family and space are reconfigured within biopolitical power structures in the production of an ideological society. Moreover, the series embodies Foucault's concepts of biopolitics and Althusser's concept of ideological apparatus at a visual level, making it a cultural and aesthetic production that lends itself to examining the family as both a social and spatial sphere of power. The Gilead regime in the series redefines the family through the concepts of fertility, obedience, and morality, transforming spatial roles into a disciplinary field where these concepts are institutionalised. Thus, the series reveals how power becomes visible through space, body, and emotion, and how modern society is reproduced on a micro scale.

The theoretical framework of this study is constructed around Michel Foucault's (1978) concept of biopolitics, Louis Althusser's (1971) approach to ideological apparatus, Henri Lefebvre's theory of the production of space

(1991), and Sara Ahmed's (2004) understanding of the cultural politics of emotions. This conceptual integration has been developed to explain the organisation of the family in the production of space, the shaping of roles in this organisation through biopolitical decisions, and the transformation of these forms into visible ideological representations in the production of society. In this context, modern power is evolving from classical forms of sovereignty to the management of life. This, in turn, places individuals under control through their biological existence. Therefore, the family, as the smallest cell of the biopolitical order, becomes the arena of life's production and discipline (Foucault, 1978). The family tends to become an ideological state apparatus within society, reflecting society, calling the individual to ideology, and placing them in their social roles. Ideological state apparatuses shape social roles based on the misconception that they aim to perpetuate a society by prioritising the sustainability of power (Althusser, 1971). Society is produced within its own space. The family participates in the production of space, and thus of society, through its forms of organisation. Mother, father and child begin to form society at its most fundamental level through the roles they assume, and the spatial forms of the family exist as ideological representations inherent in the nature of being a family (Lefebvre, 1991). Therefore, this theoretical framework provides a comprehensive theoretical basis for examining the family structure in the series The Handmaid's Tale (2017) as a visual micro-model of modern biopolitical society.

The analysis section of the study is based on a contextual analysis of semiotic and spatial practices conducted through the first season of the television series The Handmaid's Tale (2017). The analysis focuses on the spatial representations of the characters; these representations are analysed through the visual formation of individuals' social roles and the spatial practices of bodies. In this context, the spaces surrounding the characters are not analysed in detail; they are only considered as a contextual background.

In addition to the scope of the study, the literature review indicates that studies conducted on The Handmaid's Tale largely focus on themes of gender, power, language, and identity (Seymen & Eranıl, 2024; Callaway, 2008; Gayret, 2019; Gökçen, 2014; Çokay, 2012). However, the existing literature does not offer a comprehensive analysis that addresses the family–space–power relationship in a holistic manner. Güleşçe's (2023) study limits the concept of biopolitics to its impact on women in the context of the novel and does not address its role in the ideological and spatial production of family structure. Therefore, this research combines Foucault's understanding of biopolitics with Althusser's concept of ideological apparatus, positioning the family as both a biological and ideological field of production. Within this scope, it is an original study in that it aims to analyse how the family is represented in the production of society through visual narratives and roles.

1. FAMILY, BODY, IDENTITY AND ROLE IN THE SPATIAL PRODUCTION OF THE BIOPOLITICAL SOCIETY

The process of producing and reproducing society is not limited to the functioning of economic and political institutions; this process is fundamentally carried out through the institution of the family. The primary target is the core where social meaning is produced. Therefore, as the first and most effective arena where social order is reproduced, the family integrates individuals into society both biologically and ideologically. When considered within the framework of Foucault's concept of biopolitics, the family goes beyond being a structure that ensures the continuation of the lineage and becomes a micro-power field where life is managed, norms are produced, and the subject is shaped (Webb, 2020). The continuity of society, the learning of social roles by individuals, and the internalisation of emotional and moral norms are possible within this sphere. In this sense, the family is a dynamic structure where production relations, labour, care, and ideology are reproduced, as indicated by Marx's theory of social reproduction (Cammack, 2020). Feminist theories of social reproduction also define the family as the site of production of gendered forms of labour that sustain the functioning of capitalist society (Vishmidt & Sutherland, 2020). Thus, the family exists as a social and ideological reproduction mechanism; the care, education and emotional relationships established within it ensure that the individual becomes a subject compatible with the social order and, in this respect, is a tool through which social power is reproduced easily and without resistance (Porter, 1983). It is precisely at this point that the family becomes the object of biopolitical strategies through state policies, media discourses, and health regimes; life itself is made manageable through practices such as controlling fertility rates, determining parenting norms, and preserving social values (Shammas & Sandset, 2020; De Zordo, 2012).

This biopolitical transformation signifies a fundamental break from the classical forms of sovereignty of modern power. In his works The History of Sexuality, Volume I (1978) and The Birth of Biopolitics (2008), Michel Foucault emphasises that modern power has shifted from the right to kill to the regulation of life. No longer limited to punishing the body or legitimising death, power now governs, multiplies and optimises life; this represents an evolution from the power to kill to the power to sustain life. Biopolitics is a rationality of power that permeates every sphere of social life through the management of the population's health, fertility, productivity and forms of behaviour. In this process, conceptualised by Foucault as the politicisation of life, the individual ceases to be a legal subject and becomes a component of biological productivity and population management, that is, an object. Modern governance establishes a two-way logic operating between the discipline of bodies and the regulation of population (Foucault, 2008, pp. 139–140). In this

way, contemporary power creates an internalised control mechanism that encourages individuals to control their own lives and productivity rather than disciplining them directly (Bayır, 2020). This shows that biopolitics has ceased to be an apparatus of repression and has become the art of self-management. However, this is an illusion constructed through everyday life.

One of the areas where the biopolitical strategies of power are most concretely visible is the body. The concept of 'docile bodies' developed by Foucault in his work Discipline and Punish (1977) shows that modern power does not merely suppress the body but transforms it into a productive, controllable and manageable entity. Disciplinary power produces subjectivities that conform to the social order by defining all practices of the body, from its movements to its desires. In her works Precarious Life (2004) and Frames of War (2009), Butler takes this understanding to an ethical and political dimension: social norms hierarchically organise bodily existence by deciding which bodies are worthy of being lived or protected. This transforms the roles assigned through the body into spatial forms. Furthermore, Butler's concept of vulnerability indicates that the individual is defined through their biological, social recognition and capacity for protection. This is the fictional reality of the body gaining social value. The body is constrained by the definitions created by this reality.

Physical discipline formed by defined boundaries becomes fully apparent when intertwined with spatial arrangements. As Henri Lefebvre argues in his work The Production of Space (1991), space is both the product and producer of social relations; it is a social production field where economic, political, and cultural processes are concretised. The family, as the most fundamental unit of this production process, transforms the roles of mother, father and child into an ideological form through spatial practices such as seating arrangements, room distribution and dining table hierarchy. Lefebvre's approach intersects with Foucault's concept of disciplinary spaces: institutions such as schools, prisons, and hospitals are areas that keep individuals under surveillance and shape the body. The social role that the body possesses assigns it a space and, within that space, patterns of behaviour according to its role. The body moves between its physical surroundings, oscillating according to its needs and role codes. Modern governance produces 'spatial logics' that direct individuals towards certain forms of behaviour (Rose, 1999); and because of its gendered nature, space subjects the female body to the spatial codes of power in the public-private divide (Grosz, 1995); it constructs the relationship between the subject and space as an ideological adhesive (Ahmed, 2004). When these three approaches are considered together, it becomes apparent that the modern biopolitical order disciplines the body, space and emotions, thereby determining the subject's physical and emotional position. Althusser's (1971) theory of ideological state apparatuses, however, positions the family as the

ideological centre of reproduction within this spatial order; because roles are politically defined, individuals are called upon within the family and placed in their social positions.

The biopolitical structure of modern society produces a multi-layered form of power that links the family as the fundamental sphere of life management, the body as the object of discipline, and space as the vehicle of ideological production. Modern power regulates all dimensions of life by simultaneously governing the body, space, and emotions through biopolitical strategies; thus, life becomes a manageable object that can be reproduced at economic, ideological, and emotional levels.

2. METHOD

The analysis section of this study is based on a semiotic and contextual analysis approach conducted on the first season of the television series The Handmaid's Tale (2017). The analysis treats the series as a visual narrative, explaining how the spatial representations of the characters, social roles, power relations, and normative order are established on the physical and visual planes.

The spatial representations of the characters in the series were taken as the basic unit in the analysis process. The concept of spatial representation is defined as a level of representation that encompasses the visual formation of bodies within space, their positioning, and the relationships they establish with space. In this context, the study does not analyse space in detail in terms of its architectural or physical characteristics; rather, it approaches space as a contextual ground where the social roles of bodies and power relations are made visible.

The semiotic analysis process is structured based on the distinction between icons, indices, and symbols defined in Peirce's (1998) theory of signs. Within this framework:

- Iconic signs are evaluated through the visual silhouettes of the characters, their physical postures, and the formal similarities they establish with the space.
- Indexical signs were analysed through causal and relational meanings emerging from the positioning of bodies within space, movement restrictions, surveillance relationships, and spatial hierarchies.
- Symbolic signs were addressed through culturally coded and consensus-based meaning structures such as clothing colours, rituals, practices of silence, and social roles.

These three types of indicators have been examined as layers of meaning that operate together within the body–space–power relationship. Thus, the

analysis has not been reduced to individual visual elements; it has focused on interpreting the meanings produced within discursive coherence.

The analysis began with a contextual analysis, and the spatial contexts of the characters forming the family were explained in an interpretative manner in all their dimensions. Subsequently, the expressions of icons, indices, and symbolic signs were interpreted.

The research dataset consists of scenes from the first season of the series in which themes of family order, fertility regime, surveillance, and spatial control are clearly visible. Purposeful sampling was used in scene selection. The selected scenes were chosen from segments in which the characters' spatial representations were distinct and social roles were visually intense.

During the analysis process, the scenes were coded according to Peirce's classification of signs; each scene was interpreted while preserving its contextual integrity. The analysis aimed to reveal how the signs functioned within the discursive context rather than focusing on the fixed meanings of individual images.

The research is limited to the first season of the series. As the analysis focused on visual and bodily signs, dialogue, music, and sound design were excluded from the scope of the analysis.

3. THE HANDMAID'S TALE SERIES PLOT

The Handmaid's Tale is a television series developed by Bruce Miller, adapted from Margaret Atwood's 1985 dystopian novel of the same name. The series, which began airing on Hulu TV in 2017, is set in a fictional regime called the Republic of Gilead, which has transformed into a totalitarian theocracy following a fertility crisis. The series explores a social order in which individuals, particularly women, are controlled through their bodies, and reproductive capacity is subordinated to state ideology.

The narrative progresses through the main character, June Osborne (Offred). June is one of the women known as 'handmaids,' used for procreation in the homes of high-ranking officials. In Gilead, the family structure has become a biopolitical apparatus; the roles of 'Commander,' 'Wife,' 'Servant,' and 'Handmaid' are hierarchically defined to reproduce the regime's social gender order. The narrative of the series takes shape through scenes set in spaces where these roles intersect, particularly in Commander Waterford's home.

4. BIOPOLITICAL FAMILY STRATEGY AND SPATIAL REPRESENTATIONS OF THE BODY

In the Handmaid's Tale universe, the family is more of a physical unit than a social institution. Power, in reconstructing the family, elevates the

body to an ideological level. The family structure in Gilead is a theocratic and biopolitical reimagining of the modern society's nuclear family model. This structure is not a union based on "blood ties" in the traditional sense. It is based more on the redistribution of fertility and socially assigned roles based on obedience: social roles are important, not blood ties. The Gilead family (Figure 1) includes layered roles such as the father (Commander), mother (Serena Joy), handmaid (Offred), servant (Martha/Rita), driver (Nick, an extension of the surveillance mechanism, an instrument of passive power) and the child figure. In this respect, unlike the classical nuclear family (parents and children), it forms a hierarchical family structure divided according to biopolitical functions. This form, contrary to Durkheim's (1984) understanding of 'moral solidarity,' ensures social unity not through love or belonging, but through fertility and control. While the 'nuclear family' in modern societies is based on individual autonomy and emotional solidarity (Beck & Beck-Gernsheim, 2002), in Gilead, the family has become a state-owned reproductive mechanism. Therefore, the Gilead family emerges as an authoritarian variant of the modern nuclear family; however, here biological motherhood and emotional labour are divided and reproduced in different bodies. In line with Foucault's (1978) concept of 'the management of life,' the Gilead family becomes a biopolitical micro-management space that treats the body as both an object of production and discipline.

Figure 1: *Gilead family structure, Season 1, Episode 9, min: 02:18 (Miller, 2017).*

When examining family organisation and formal roles, the Commander (Figure 2) in Gilead's family structure represents the physical centre of both the patriarchal order and ideological continuity. The Commander character is the authority figure at the top of Gilead's biopolitical hierarchy, a citizen with the right to speak, an active role in society; his body makes this power

structure visible on a spatial and emotional level. His posture is upright, his shoulders broad; his movements are measured and slow. This 'uprightness' embodies Lefebvre's (1991) 'ideology of height,' which he describes as the spatial projection of social hierarchy (p. 229). The Commander's gait, posture, and manner of speaking reproduce the architecture of social order.

Figure 2: *Commander, Season 1, Episode 5, min: 06:59 (Miller, 2017).*

The Commander's attire is a visual expression of authoritarian representation. He typically wears dark-toned suits in black, navy blue, or dark grey; these colours symbolise both emotional coldness and the neutrality of power. The stiff texture of the fabric creates a kind of 'shell of discipline' around the body. The fabric envelops the body, transforming into the tactile form of power. The commander's attire is not a personal garment but an institutional uniform; it represents a 'state body.' In this respect, every part of the attire, the tightness of the tie, the structural stiffness of the jacket, the shine of the shoes, completes the body's controlled posture.

The commander is mostly seen in his study, the living room, at the dining table, or in ceremonial spaces; these areas are the routine scenes of his authority. The fact that his attire remains unchanged in every space emphasises the continuity of power in both the public and private spheres. Here, the body represents authority and distance; even the silence within the home becomes an instrument of control, and power operates through intonation, posture, and rhythm rather than words. The Commander's silence, stillness, and slow movements are imperious signs; this silence is 'the silence of authority'. Socially, the Commander is the 'central fixed point' of the family; however, this fixedness is fragile due to the nature of being human and the continuity of life. The Commander's body must remain constantly 'cool-

headed' and 'controlled' to balance this fragility, representing the masculine form of biopolitical self-control.

Another role, that of Commander's Wives (mothers) (Figure 3), is the physical embodiment of emotional discipline and sacred womanhood. In the Gilead regime, 'Commander's Wives' represent a biopolitically rewritten form of womanhood. These women are figures deprived of fertility but sanctified by the status of 'motherhood'; their social role is not so much to be productive bodies as to be guardians of the moral order and bearers of ideological motherhood. The concept of motherhood in Gilead operates on a symbolic rather than a biological level: they do not give birth, but 'behaving like a mother' becomes their ideological duty. Giving birth to a baby and feeding it biologically are outside their life experiences, so they are only caregivers and nurturers. Wives constantly repeat performances of obedience, dignity, and emotional composure to produce the identity of 'sacred womanhood.'

Figure 3: *Commanders' wives, mothers, Season 1, Episode 5, min: 13:43 (Miller, 2017).*

The physical form and clothing aesthetics of these figures visually encode the regime's emotional and moral order. Long, closed dresses in thick, dark blue tones symbolise 'purity,' 'faith,' and 'obedience,' while also controlling the female body. The stiffness of the fabric translates into restricted movement; clothing that delineates the body's boundaries also determines a woman's place in society. The spouses' bodies are a visualisation of obedience transformed into muscle memory. Their slightly bowed heads, arms mostly clasped in front of their chests, silent but approving gazes, are a choreography that transforms all emotional discipline into bodily gestures. They exhibit patterns of behaviour that represent patience, compassion and a sense of control.

Within the house, these women are visible in spaces situated on the controlled, public-private boundary, such as the sitting room, garden, and

ceremonial areas. These spaces reinforce their silent surveillance roles; although visible at the heart of the house, their access to the study, the domain of power production, is limited. In the bedroom, the scene of fertility, they assume the role of guardian during ceremonies (in the series, the sexual union between the commander and the handmaid is referred to by this name and sanctified), ensuring control over the handmaid.

Gilead wives thus transform the concept of 'motherhood' into an instrument of emotional control. Their motherhood is not protective but regulatory; not affectionate but instructive; not nurturing but disciplining. Here, women's labour is based on emotional and ideological reproduction. The Gilead mother is the regime's most visible yet most constrained body, the elegant embodiment of power, the ideal form of emotional discipline. She occupies the position of the family's complement and integrator.

The role of the Handmaid (Figure 4) represents the most explicit form of biopolitical management of life within the family structure in Gilead. Handmaids, a group of women that includes the character Offred, are physical vessels who fulfil the function of fertility within the family but can never claim motherhood. The female body is transformed into public property through its capacity for fertility. After giving birth, they are assigned to the homes of other commanders, meaning they are interchangeable family members within the family structure. They are selected from women who have given birth and forcibly assigned to breeding duties. The red dress covering her entire body, the cape coat, and the white cape that completely obscures her vision are symbols of both fertility and danger; the colour is not a sign of emotional obedience but an ideological stamp. Red is imposed on the body not as the colour of desire but as the colour of belonging to the regime. She has no right to speak; her body is an object, a tool of fertility.

Figure 4: *The Handmaids, Season 1, Episode 5, min: 12:09 (Miller, 2017).*

Handmaids in the Gilead family are merely 'biological production devices'; their bodies are both protected and controlled. Their clothing reflects this contradiction: while their red dresses are revealing in their visibility, their white bonnets visually confine them, directing the gaze and thus defining the limits of desire. The Handmaid's body sustains the 'performance of obedience' while simultaneously breaking it. Offred 'plays the ideology wrong' by slowing her walk, not averting her gaze, or using her silence. This body is shaped by anarchic attitudes and a disciplinary understanding, yet it also carries the potential for resistance. In public spaces, they walk in pairs, one behind the other. Although they are not forbidden to talk to each other, any behaviour that disrupts the rhythm of the march is immediately controlled by security. The handmaids assigned to the commanders' homes are named by adding "of" before the commander's name and become subordinate to the commander's identity. The spiritual counterparts of the handmaids are defined only in terms of sexual intercourse, and lust is forbidden in this union.

The family structure in Gilead is not limited to the Commander, his wife, and the handmaid; the figures of the maid, the driver, and the child surrounding this core structure are both the sustainers and the support units of the order. These characters form the invisible bodies of the biopolitical system that make the order sustainable, acting as the family's 'lower strata': service, surveillance, and biopolitical future. These bodies serve to reproduce daily discipline.

Marthas (servants) (Figure 5) are the ideological bearers of domestic labour. Their simple, thick-fabric garments in green tones are associated with both nature and service; the colour represents productivity and obedience combined. Their heads are perpetually bowed, their movements silent; this posture renders visible both the hierarchy of the space and the embodied form of obedience. Marthas occupy the lowest rung of the family structure, maintaining the household's operations as an invisible ritual. Their bodies carry the silence of obedience.

Figure 5: *Martha, the maid, Season 1, Episode 1, min: 09:02 (Miller, 2017).*

Drivers (Nick) (Figure 6) represent the neutral face of power. They wear plain uniforms in shades of black and grey; these colours symbolise invisibility and distance. Nick's body represents a watchful silence. Nick obeys authority without being seen; surveillance is his mode of action, silence his sign of loyalty. Thus, the modern model of 'soft' masculinity is reproduced through the body in Gilead.

Figure 6: *Driver, lookout, Season 1, Episode 1, min: 02:23 (Miller, 2017).*

The child figures (Figure 7) represent the future of Gilead's biopolitical project. Their simple pastel-coloured clothing is a visual code for 'sacred innocence' and 'belonging'. The feeling of love directed towards these children reinforces the regime's continuity: love becomes a biopolitical bond. Here, the child is less an individual than a symbol of the state's reproduction strategy.

Figure 7: *The Children of Gilead, Season 1, Episode 1, min: 13:04 (Miller, 2017).*

As a result, the maid, driver and child figures are visualised as the 'complementary mechanisms' of the family in Gilead. They ensure the silent but constant flow of power: one through service, one through surveillance, and the other through the continuity of fertility. Thus, the Gilead family becomes a microcosm of power as well as an emotional and physical production machine.

Table 1: *The Biopolitical Representation of Body, Clothing and Ideological Position*

Character	Bodily Configuration (Form)	Clothing and Color Codes	Emotional Code	Ideological Role / Social Function
The Commander	Upright posture, fixed gaze, expansive spatial presence	Dark tones (black, navy); neutral signifiers of power and control	Cold authority, silent dominance	Central figure of patriarchal discipline; regulator of public space
Serena Joy	Body constrained by tight clothing, lowered head, restricted movement	Dark blue; representation of piety and noble obedience	Suppressed anger, sanctified patience	Emotional apparatus of ideological motherhood; internalized face of patriarchy
Offred (June)	Controlled movement, deliberate silence, resistant gaze	Red dress and white bonnet; contradictory symbols of fertility and obedience	Silent resistance, internal revolt	Subject who responds incompletely to ideological interpellation; potential site of "deviation" within the system

Rita	Bent posture, silent body, shadow-like presence	Shades of green; color of service, lower status, and invisible labor	Acceptance, weary loyalty	Invisible laborer of the spatial underclass; carrier of domestic order
Nick	Neutral masculinity, withdrawal, observant stance	Simple gray-black clothing; markers of anonymity and ambiguous power	Constrained desire, emotional coolness	Carrier of passive power; micropolitical observer
Child Figures	Small, directed bodies, mechanical movement	Light pastel colors; ideological coloring of innocence	Sacred innocence, belonging	Representation of the biopolitical future; symbol of regime continuity

The physical, emotional, and sartorial configurations of the characters listed in Table 1 demonstrate that the 'family' in The Handmaid's Tale universe has ceased to be a family in the classical sense, transforming into a biopolitical order where public power permeates the private sphere, determining the essence of life. Although each character appears to be a family member, these roles are not formed by emotional or kinship ties. The bond is defined by physical and emotional codes determined by power. The Commander represents the verticality of authority, the Wife the elegance of emotional discipline, the Handmaid the obedience of fertility, the Maid the invisibility of silent labour, the Driver the masculine control of surveillance, and the Children the continuity of the regime. In this structure, the 'family' is a space of surveillance, discipline, and reproduction. Therefore, the picture clearly reveals that the family model in Gilead is actually a microcosm of power; it transforms into a biopolitical laboratory where each individual contributes to the functioning of the regime through their body and emotions.

4.1. Inconsistencies in the Icon, Index, Symbol and Family Structure

Table 2 analyses the physical and spatial representations of the characters constituting the Gilead family structure based on Peirce's icon–index–symbol distinction. Thus, the relationship between the visual image of the body (icon), its spatial positioning (index), and its ideologically coded meaning (symbol) is explained; revealing how the family structure functions as a biopolitical micro-management area.

Table 2: *Icon, index and symbol in the biopolitical family.*

Character / Role	Icon (Visual Resemblance / Form)	Index (Spatial–Causal Relation)	Symbol (Cultural / Ideological Code)	Biopolitical Meaning
The Commander	Upright posture, broad shoulders, heavy and slow movement; central position within space	Constant visibility in the study, dining table, and ceremonial spaces → the bodily center of power	Dark suit, tie → patriarchal authority and state rationality	The body transforms into a "state body" that carries the continuity of power
Commander's Wife (Serena Joy)	Controlled body, lowered head, limited gestures; dignified silhouette	Positioned in living rooms, gardens, and ceremonial spaces → zones of emotional regulation	Dark blue clothing → sacredness, obedience, ideological motherhood	The female body becomes the carrier of emotional discipline and moral order
Handmaid (Offred)	Red dress, white bonnet, controlled walking → visible yet restricted body	Bedroom (ceremony), public walking routes → spatial indices of fertility	Red color → fertility + danger; "of + name" → erasure of personal identity	The body is reduced to a biological apparatus transformed into state property
Martha (Domestic Servant)	Bent posture, silent movement, remaining in the background	Kitchen and back rooms → spaces of invisible labor	Shades of green → service, productivity, obedience	The silent body sustains the biopolitical order through invisible labor
Driver (Nick)	Neutral body, withdrawn stance, lack of expressive gaze	Doorways, vehicles, exterior spaces → points of surveillance	Gray–black uniform → anonymity, passive power	Surveillance takes the form of a masculine yet invisible mode of power
Child Figure	Small, directed body; mechanical movement	Protected positioning within domestic and ceremonial spaces	Pastel colors → innocence, belonging	The child functions as the symbolic carrier of the regime's biopolitical future

The most apparent contradiction in Gilead's biopolitical family order becomes visible in the disconnect between fertility and motherhood. Although the biological bond established by the handmaids through birth is rejected by the regime's official ideology, this bond leaves indelible marks both on the baby's perception of physical security and on the handmaid's sensory and biological memory. Within the framework of Peirce's semiotic distinction,

this bond persists as an indexical sign inscribed on the body through the act of birth. In contrast, the regime's regulation, which attributes motherhood to commanders' wives, produces a symbolic motherhood based not on a biological foundation but on ideological compromise. Therefore, the tension between the body's indexical memory and the symbolic representation of motherhood leads to the constant failure of the ideological construct. The birthing body, precisely at this point, even if presented as an apparently obedient icon, becomes a silent space of resistance through its biological memory.

The efforts of commanders' wives to claim the 'role of motherhood' can also be read as an extension of this contradiction. Their physical postures, ceremonial gestures, and dignified performances produce iconic representations of motherhood; while behavioural patterns that repeat the statement 'I am the real mother' reflect the constant effort to re-establish symbolic motherhood. However, this symbolic appropriation produces unconscious competition and identity compensation because it does not correspond to the indexical reality representing the fertility power of the brood hen. Thus, the ideological myth of motherhood not only suppresses the brood hen's body but also becomes a mechanism of division that weakens potential solidarity among women from within.

Another fundamental conflict manifests itself in the clash between sexuality and the tension between public discipline and private desires. While the Gilead regime's dogma of 'sacred procreation' symbolises sexuality solely as a controlled and functional practice, the secret lustful relationships established by the commanders with the handmaids undermine this symbolic order from within. Although forbidden desire is presented as a repressed symbol in the public sphere, it becomes an indexical impulse that reappears in the male body. This situation reveals that patriarchal power cannot fully discipline even its own body and that the male body is also a contradictory bearer of power.

In the face of these contradictions, the roles of womanhood and motherhood are fragmented. While commanders' wives struggle to maintain their existence amid the tension between emotional betrayal and symbolic motherhood, the handmaids seek to establish their own subjective spaces by disrupting the iconised appearance of obedience in their bodies through silence, gaze, and rhythm. In contrast, the system perpetuates the illusion of male perfection by placing the burden of fertility solely on the female body. Thus, although the Gilead family appears to be a closed structure regulated by bodily control, it is a dynamic yet contradictory organisation where desire, motherhood, and identity are in constant conflict due to the incompatibilities between icon, index, and symbol.

Consequently, the Gilead family system, woven with the principles of control and discipline of power, becomes a system that constantly denies itself due to its internal biological and emotional inconsistencies: mothers who are not mothers, men who are symbolically asexual but physically desiring, bodies that give birth but cannot possess... Gilead's order, while attempting to control bodies in order to restrain spirits, produces the regime's uncontrollable breaking points through the seepage of suppressed indexical traces and symbolic cracks.

CONCLUSION

Throughout history, the family has been one of the ways in which power has managed life. In modern societies, although the family is legitimised as a structure based on love, commitment and solidarity, it essentially lies at the heart of power's strategies for regulating, controlling and reproducing life. As Michel Foucault (1978) has argued, modern power is based on the management of life; this situation demonstrates that individuals, as subjects compelled to obey, are transformed into biopolitical entities whose lives, fertility, desires, and emotions are regulated. Consequently, the family becomes the smallest but most effective ideological and biopolitical unit of modern society.

This study examines The Handmaid's Tale series to demonstrate how the family structure is reproduced and visually shaped within a biopolitical framework. The series reveals how the family, seen as a space of love and belonging, has been transformed into a micro-level control mechanism through which power operates via the body, space, and emotion. In Gilead society, the family is no longer a space where individuals express their subjective existence. The analysis in this study shows that The Handmaid's Tale constructs the family as an ideological stage. The Commander character represents the spatial and bodily projection of authority, while the Commander's wife embodies emotional discipline and ideological motherhood. The Handmaids symbolise the transformation of fertility into public property, the maids symbolise the invisibility of silent labour, the drivers symbolise the surveillance mechanism, and the children symbolise the biopolitical future. In these roles, love gives way to obedience; care gives way to surveillance; and fertility gives way to an ideological duty. Just as the physical form of each role carries ideological meaning, so too does their clothing, defining the social hierarchy in Gilead. Commanders, dressed in simple, formal attire in dark tones (black or navy blue), represent power, discipline, and control; these colours symbolise the neutral, unchanging nature of authority. Commanders' wives wear dark blue clothing, a tone that evokes piety, obedience, and the ideals of 'sacred motherhood.' The brood mares, in their red dresses, have been made symbols of fertility, blood and life; their white headdresses have been both a means of purity and visual isolation. Servants, in their green outfits, represent domestic labour and lower status; with their silence, they are the invisible bearers of

the ideological order. Drivers typically wear plain uniforms in grey or black tones; these neutral colours reflect their intermediate status, close to power but emotionally effaced. Children, dressed in light pastel colours, become an extension of innocence and the regime's ideology of a 'clean slate' for the future.

Gilead's family model transforms the private sphere into an extension of the state's power strategies. This structure, which visually ensures the daily reproduction of society, harbours incompatibilities within the context of human nature, motherhood, love, desire, and relationships. Although the biological bond that comes with birth is disregarded, the sense of trust between the handmaid and the baby persists. The commanders' inclination towards lustful urges towards the brood mares and the attribution of fertility problems solely to women weakens the biopolitical family structure in the film. The concept of motherhood, whose meaning has been altered as a social code, turns into a conflict between the brood mares and the commanders' wives, sabotaging female solidarity.

The historical roots of the biopolitical family can be traced back to Ancient Rome. The legalisation of marriage and fertility as legal obligations through Augustus' Lex Julia and Lex Papia Poppaea laws (Galinsky, 1996), the sanctification of marriage as a religious duty in medieval Europe, the centralisation of the concepts of motherhood and morality in population policies in 19th-century Europe (Donzelot, 1979), and the transformation of women's bodies into national production tools through the Lebensborn Programme in Nazi Germany (Burleigh & Wippermann, 1991) demonstrate that the family has historically been part of the biopolitical project of power. The Handmaid's Tale dystopically reproduces this historical continuity: fertility, morality, and family values are severed from the individual's subjective life and integrated into the disciplinary logic of the state.

Consequently, the family is a micro-power sphere where public power infiltrates the private sphere and the essence of life is governed. In today's world, discourses on protecting family values, state policies aimed at increasing birth rates, and the legal regulation of parenting norms constitute updated forms of this biopolitical logic. In the modern biopolitical society, the family persists both as the unit of life production and as the most invisible yet most effective ideological apparatus of power.

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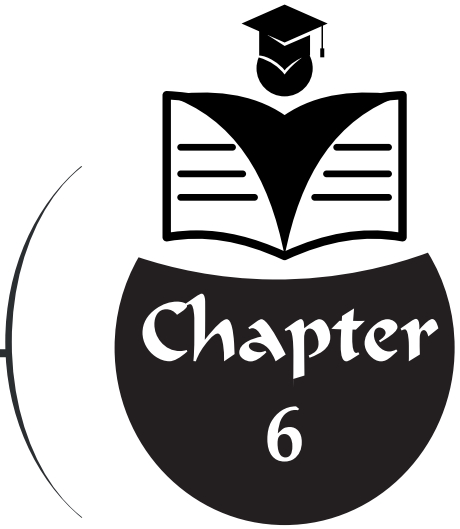

THE ANATOMY OF MUSIC: ENTROPY FROM THE DISSOLUTION OF CLASSICAL AND TRADITIONAL ORDER TO TECHNOLOGICAL TRANSFORMATION

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1. Introduction: The Entropy Paradigm in Music

The idea that music possesses an anatomy—a structural body composed of interdependent organs—is more than a metaphor. It is an epistemological framework for understanding how pitch, rhythm, timbre, and form interact to produce coherent aesthetic experience. A musical composition sustains perceptual coherence through the management of expectation and surprise (Meyer, 1956; Huron, 2006). When surprise overwhelms expectation, or predictability flattens into monotony, the musical body enters a state that can be productively described as entropic.

The concept of entropy, formalized in Claude Shannon's information theory (Shannon, 1948), provides a rigorous vocabulary for measuring unpredictability in a system. In the musical domain, entropy has been applied to melodic contour analysis (Temperley, 2007), harmonic progression modeling (Rohrmeier & Graepel, 2012), and rhythmic complexity evaluation (Pressing, 2002). Yet entropy also functions as a broader cultural metaphor: the story of Western music from the Renaissance to the present can be told as a narrative of increasing entropy—from the ordered modal polyphony of Palestrina to the deliberate embrace of randomness in John Cage's aleatory experiments (Nyman, 1999).

This chapter pursues a dual argument. First, it contends that entropy is not merely a descriptive tool but a generative principle driving musical evolution. Viewed through information theory, thermodynamics, and aesthetic philosophy, Western and non-Western art music reveals a trajectory from low-entropy tonal order toward high-entropy dissolution, followed by technologically mediated re-ordering. Composers actively negotiate the boundary between predictability and surprise, producing new forms of order at each historical juncture. Second, technology—from the tempered keyboard to the neural network—has served as the primary mechanism through which entropy is managed and redefined. The modal traditions examined later—particularly the Turkish makam and the Indian raga—reveal alternative entropy dynamics that resist the Western teleological narrative. The discussion proceeds through five thematic sections: the anatomy of pre-entropic order (Section 2), the dissolution of tonality (Section 3), modal alternatives (Section 4), the theoretical architecture of musical form (Section 5), and the technological transformation of musical entropy (Section 6).

2. The Anatomy of Order: Pre-Entropic Structures

2.1. Renaissance Foundations: From Modality to Incipient Tonality

The Renaissance marks the period in which European music first achieved systematic regulation of vertical sonority. The modal system—codified in Glarean's Dodecachordon (1547) and expanded to twelve modes—provided

a framework of intervallic relationships constraining melodic and harmonic behavior (Powers et al., 2001). In information-theoretic terms, modality constituted a low-entropy environment: the probability distribution of pitch events was heavily skewed toward the finalis, and dissonance was governed by strict contrapuntal rules articulated by Zarlino (1558) and Fux (1725). The transition from modality to tonality in the early seventeenth century represents a crucial entropy event. Tonality, as Dahlhaus (1990) argued, is a fundamentally different organizational principle based on the gravitational pull of a single tonic and the functional hierarchy of scale-degree chords. This transition reduced harmonic entropy while increasing melodic and rhythmic freedom within the tonal scaffold (Tymoczko, 2011).

2.2. Baroque Systematization: Harmony and Counterpoint

The Baroque consolidated tonality into a comprehensive system of harmonic function. Rameau's Traité de l'harmonie (1722) formalized the low-entropy grammar of tonal progression (Christensen, 1993), while the contrapuntal tradition reached its zenith in Bach's fugal procedures—self-referential structures achieving maximal coherence within strictly defined rules (Hofstadter, 1979). The circle-of-fifths progressions dominating Baroque sequential writing are among the most statistically predictable patterns in Western music, as computational corpus analyses have confirmed (Moss et al., 2019). Yet this predictability created conditions for local entropy fluctuations: the concerto grosso's tutti–solo alternation and the suite's juxtaposition of dance types introduced controlled bursts of novelty within a stable framework (Bukofzer, 1947).

2.3. Classical Zenith: The Skeleton of Form

The Classical period refined the relationship between local and global entropy through large-scale formal archetypes. Sonata form established a dialectical structure of tonal departure and return regulating the listener's experience across extended temporal spans (Hepokoski & Darcy, 2006). The exposition's modulation creates tonal disequilibrium—an entropy increase—that the recapitulation resolves by restoring the tonic (Caplin, 1998). Beethoven's middle-period works stretched these norms, introducing structural ambiguities that elevated formal entropy beyond Classical precedent (Bonds, 1991).

2.4. Romantic Fissures: Chromaticism and Rising Entropy

The Romantic period systematically eroded the tonal system's predictive constraints. Wagner's Tristan und Isolde (1865) is the locus classicus: its opening chord resists unambiguous functional classification, raising harmonic entropy to unprecedented levels (Bailey, 1985). The late-Romantic trajectory from Liszt through Strauss to Mahler constitutes progressive

entropy escalation, each composer widening the probability distribution of harmonic events and attenuating the tonic's gravitational pull (Kramer, 2002). By the early twentieth century, the tonal system had reached a critical point—a threshold beyond which it transitions to a qualitatively different state.

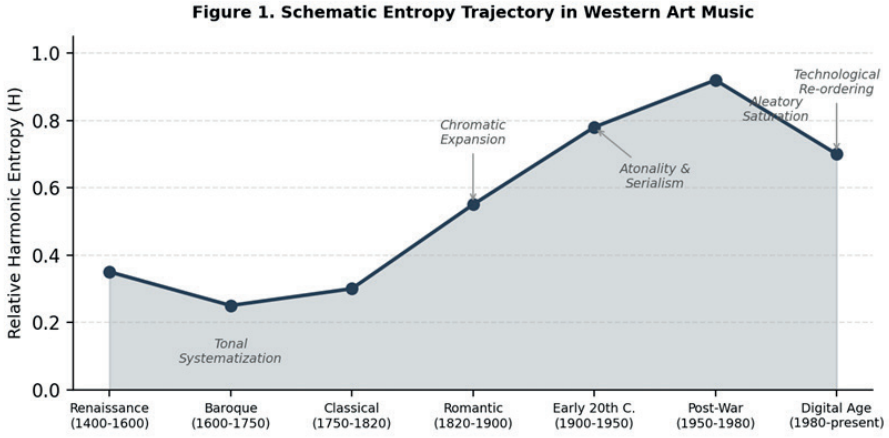

Figure 1. Schematic entropy trajectory in Western art music. The vertical axis represents relative harmonic entropy (H), illustrating the rise through Romantic chromaticism and twentieth-century atonality, followed by partial re-ordering through technological mediation.

3. From Fissures to Dissolution: The Rise of Entropy

3.1. The Dissolution of Tonality and Serialism

Schoenberg's atonal works of 1908–1912—the Second String Quartet, Op. 10, the Three Piano Pieces, Op. 11, and Pierrot lunaire, Op. 21—enacted the definitive break with tonal order. By abandoning key signatures and functional harmonic progressions, Schoenberg maximized pitch entropy: all twelve chromatic pitches became equiprobable, eliminating the hierarchical weighting that had defined tonality (Perle, 1991). Listeners could no longer rely on internalized tonal schemas, and the phenomenological experience shifted from guided narrative to unmediated confrontation with sonic events (Adorno, 1949/2006). The twelve-tone method, formalized in the early 1920s, attempted to re-impose order by organizing all twelve pitches into a fixed row and deriving material from its permutations—a constraint based on abstract combinatorial logic rather than perceptual salience (Straus, 2005). The entropy was redistributed rather than reduced: the row imposed sequential constraints while the perceptual surface remained highly unpredictable (Lerdahl, 1992).

Figure 2. Entropy Analysis of Pitch Organization

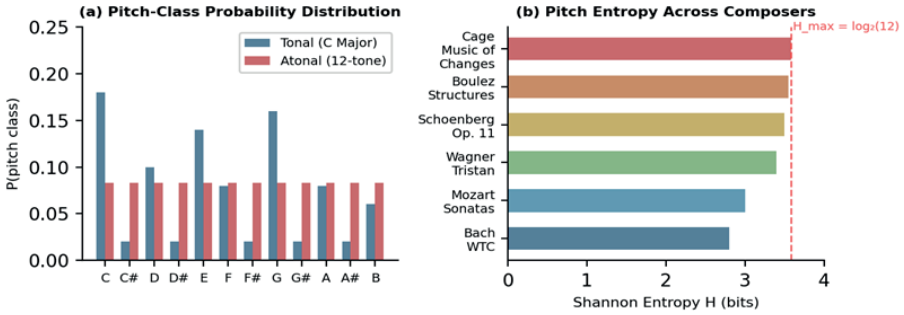

Figure 2. Entropy analysis of pitch organization. (a) Pitch-class probability distributions in tonal versus atonal contexts; (b) Shannon entropy values (H, bits) for representative works, approaching $H_{max} = \log_2(12) \approx 3.585$ bits.

3.2. New Harmonic Explorations and Formal Challenges

The post-war generation—Boulez, Stockhausen, Nono—extended serialism to duration, dynamics, articulation, and timbre, producing total serialism (Grant, 2001). Boulez's Structures Ia (1952) serialized all four parameters, generating such complexity that the result approached perceptual randomness. Paradoxically, maximizing compositional control minimized perceptual order: listener-perceived entropy became indistinguishable from stochastic noise (Xenakis, 1971/1992). This stimulated alternatives: Lutosławski's limited aleatoricism framed ad libitum passages with precise structural pillars (Stucky, 1981); Ligeti's micropolyphony in Atmosphères (1961) and Lontano (1967) dissolved individual lines into evolving timbral masses, converting high-entropy polyphony into low-entropy spectral drift (Steinitz, 2003).

3.3. Aleatory Music and Indeterminacy

If serialism managed entropy through hyper-control, the aleatory tradition embraced it as a principle. Cage's Music of Changes (1951), composed via I Ching chance operations, maximized the entropy of the creative process itself (Pritchett, 1993). His subsequent works—4′33″ (1952), the Concert for Piano and Orchestra (1958)—dissolved the distinction between composition and environment (Kahn, 1999). By equating composition with the acceptance of entropy, Cage challenged the assumption that art is the imposition of order upon chaos, resonating with cybernetics (Wiener, 1948), information theory (Shannon, 1948), and chaos theory (Gleick, 1987).

3.4. Notation and Performance Problems

The increasing entropy of composition created corresponding crises in notation and performance. Traditional notation, designed for low-entropy

tonal parameters, proved inadequate for serial, aleatory, and electronic works (Stone, 1980). Penderecki's graphic scores, Feldman's graph notation, and Stockhausen's text scores each addressed the problem differently, all reflecting the challenge of encoding high-entropy information in finite symbolic systems (Karkoschka, 1972). The performer's role shifted from reproduction to co-creation, raising philosophical questions about authorship and the ontological status of the musical work (Eco, 1962/1989; Goehr, 1992).

3.5. The Apex of Entropy: The Aesthetics of Chaos

By the 1960s–70s, Xenakis's Metastaseis (1954) and Pithoprakta (1956) applied stochastic mathematics to orchestral textures, composing with entropy itself as a structural parameter (Xenakis, 1971/1992). His insight—that individually random events produce statistically predictable macro-structures—bridged micro-level chaos and macro-level form (Harley, 2004). Adorno (1949/2006) warned that total emancipation of material risked new unfreedom; Nattiez (1990) argued that the gap between compositional intention and listener reception threatened communicative collapse. These critiques pointed toward re-evaluation—one that would come partly from non-Western traditions.

4. Modal Orders: Alternative Anatomies Beyond Tonality

4.1. Theoretical Frameworks of Modality and Makam Systems

The Western entropy narrative is not universal. Modal systems—Turkish makam, Arabic maqam, Persian dastgah, Indian raga—regulate entropy through melodic path constraints and hierarchical pitch relationships rather than functional harmony (Powers, 1980; Signell, 1977). In the Turkish makam system, each makam prescribes a seyir (melodic trajectory): an opening region, a developmental path, and a cadential return to the karar (finalis), managing expectations without harmonic function (Aydemir, 2010; Özkan, 2006). The entropy profile differs fundamentally from tonal systems: where tonal entropy is regulated harmonically, modal entropy is regulated melodically. Statistical models trained on Western corpora may produce misleadingly high entropy values for music that is internally highly ordered (Bozkurt et al., 2014).

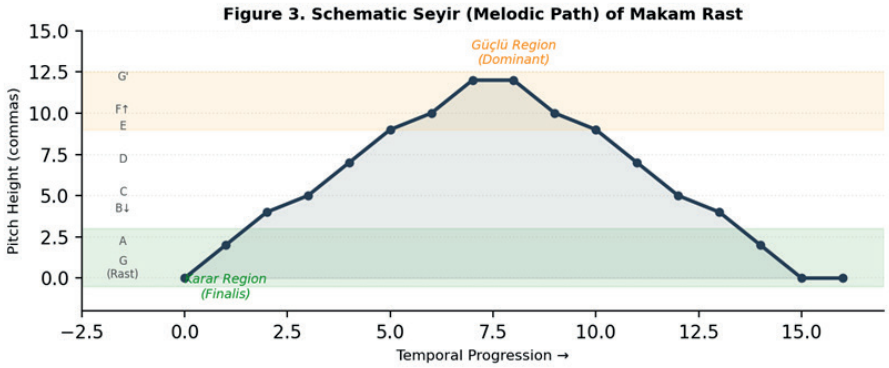

Figure 3. Schematic seyir of Makam Rast. The trajectory illustrates the ascent from the karar region through the güçlü (dominant) region and the subsequent descent, demonstrating modal entropy management through prescribed melodic contour.

4.2. Polyphonic Experiments in Modal Traditions: The Turkish Case

The encounter between modal monophony and Western polyphony represents a major cross-cultural entropy event. In Turkey, harmonizing makam melodies—pursued by Saygun and Erkin during the early Republican era—confronted structural incompatibility: the makam system's microtonal intervals could not be accommodated within equal temperament (Aksoy, 1985; Signell, 1977). Forcing makam melodies into equal temperament distorted characteristic intervals, increasing entropy; applying Western harmony without temperamental adjustment violated modal intonational expectations, producing a different perceptual entropy (Ayangil, 2008; Ederer, 2015). This tension between melodic and harmonic entropy regimes remains central to Turkish art music.

4.3. Structural Problems and Aesthetic Experience

Modal systems face internal entropy challenges independent of Western influence. The Turkish fasıl tradition organizes composed and improvised forms within a single makam, managing large-scale formal coherence without harmonic teleology (Feldman, 1996). Taksim sections introduce controlled entropy through melodic exploration; composed sections restore order through familiar formulas and rhythmic patterns (usul). This alternation parallels sonata form's tonal departure-and-return dialectic through entirely different parameters.

4.4. Cross-Cultural Encounters and Hybridization

The Indian raga system provides another instructive model: each raga defines permissible pitches, characteristic phrases (pakad), temporal context (samay), and emotional affect (rasa), creating multi-parametric order resisting reduction to a single dimension (Clayton, 2000; Jairazbhoy, 1995).

Contemporary cross-cultural experiments and computational analyses have developed frameworks comparing entropy profiles across traditions, suggesting that entropy management is universal in musical cognition, though culturally manifested (Pearce, 2005; Serra, 2011). The globalized hybrids—from Bartók's folk-inflected modernism to jazz-makam fusions—create novel entropy profiles requiring simultaneous modeling of incommensurate systems (Bates, 2011).

5. The Anatomy of Music: Form, Theory, and Structure

5.1. The Musical Body Metaphor

The anatomical metaphor invites consideration of music as an integrated system: melodic, harmonic, rhythmic, and timbral subsystems cooperate to sustain coherence, and the entropy of the whole emerges from their interactions (Zbikowski, 2002; Kauffman, 1993). Lerdahl and Jackendoff's (1983) generative theory modeled cognition as a hierarchical system of preference rules; Tymoczko's (2011) geometric approach revealed voice-leading regularities persisting across styles.

5.2. Melody, Harmony, and Their Coupling

In tonal music, melody and harmony are coupled: harmonic progression constrains melodic pitches, and voice-leading constrains harmonic choices, reducing overall entropy below what independence would yield (Aldwell, Schachter, & Cadwallader, 2011). Schenker's (1935/1979) structural levels formalized this coupling. In post-tonal music, decoupling increases entropy dramatically; composers respond with alternative coupling mechanisms: motivic saturation, set-class equivalence (Forte, 1973), spectral harmony (Fineberg, 2000), and algorithmic derivation from harmonic spectra (Murail, 2005).

5.3. Rhythm and Time

Hasty's (1997) reconception of meter as a dynamic process of projection and confirmation reveals rhythm's fundamentally entropic character; London's (2012) model treats metric entrainment as resonance between listener and periodic structure. Stravinsky's metric disruptions, Messiaen's non-retrogradable rhythms, and Carter's metric modulation represent progressive rhythmic entropy increase paralleling the harmonic escalation discussed above (Schiff, 1983).

5.4. Variation Technique

Variation form makes the order–transformation relationship explicit: a low-entropy theme undergoes progressive entropy increase through ornamentation, reharmonization, and timbral transformation while maintaining recognizable connection to the original (Sisman, 1993). The

listener's monitoring of distance from the initial state is formally analogous to measuring entropy relative to a reference distribution (Kullback & Leibler, 1951).

5.5. Uncertainty, Creativity, and the Entropy Balance

The entropy–aesthetic relationship is not monotonic. Berlyne's (1971) inverted-U hypothesis proposed that pleasure peaks at intermediate complexity; empirical research on musical preference supports this (North & Hargreaves, 1995), and computational models of expectation have formalized it (Pearce & Wiggins, 2012). Successful composition calibrates entropy to an optimal level subject to historical and cultural variation.

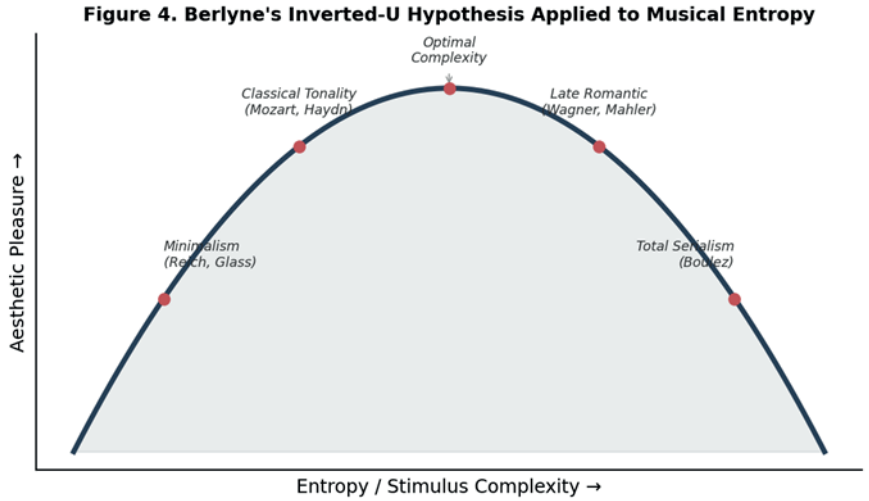

Figure 4. Berlyne's inverted-U hypothesis applied to musical entropy. Aesthetic pleasure peaks at intermediate complexity; specific musical styles are positioned along the entropy axis.

6. Technological Transformation: AI and New Paradigms

6.1. Digitalization and Its Theoretical Reflections

The digital revolution has altered the material substrate of musical production. Converting sound to discrete numerical representations is itself an entropy-modifying operation: quantization reduces entropy through discretization, compression through redundancy removal (Roads, 1996; Sterne, 2012). Digital tools enable sonic events of arbitrarily high parametric complexity, potentially exceeding entropy levels achievable acoustically.

6.2. AI-Assisted Composition and Analysis

Machine learning models—recurrent networks, transformers, GANs—produce output mimicking the entropy profile of training data, raising

questions about creativity and musical intelligence (Briot, Hadjeres, & Pachet, 2020). MuseNet, Magenta, and MusicGen demonstrate increasing sophistication in managing generated musical surfaces (Dhariwal et al., 2020; Copet et al., 2023). Analytically, Conklin and Witten's (1995) multiple viewpoint systems decomposed corpus entropy by dimension, and Pearce's (2005, 2018) models capture real-time expectation dynamics.

6.3. Soundscape and Spatial Hearing Aesthetics

Schafer's (1977) soundscape concept dissolves the music/non-music boundary, maximizing the entropy of the category itself (Truax, 2001). Spatial audio technologies—ambisonics, wave field synthesis, binaural rendering—add three-dimensional positioning as a compositional parameter (Rumsey, 2001).

6.4. Neuroscientific Approaches: Brain–Music Interaction

Neuroimaging shows that unexpected harmonic events activate regions involved in syntactic processing (Koelsch, 2011), while the dopaminergic reward system responds to the resolution of musical tension (Salimpoor et al., 2011; Gold et al., 2019). These findings confirm that entropy management is a fundamental determinant of musical meaning and emotional impact.

6.5. Algorithmic Chaos and the Search for New Order

Voss and Clarke's (1975) finding that music's spectral density follows a 1/f distribution—indicating self-similar structure across temporal scales—positions music between white noise and Brownian noise. Subsequent research confirmed 1/f scaling as near-universal, with deviations perceived as aesthetically inferior (Levitin, Chordia, & Menon, 2012). Algorithmic systems generating 1/f output—L-system grammars, cellular automata, iterated function systems—compose at the edge of chaos (Miranda, 2001; Burraston & Edmonds, 2005).

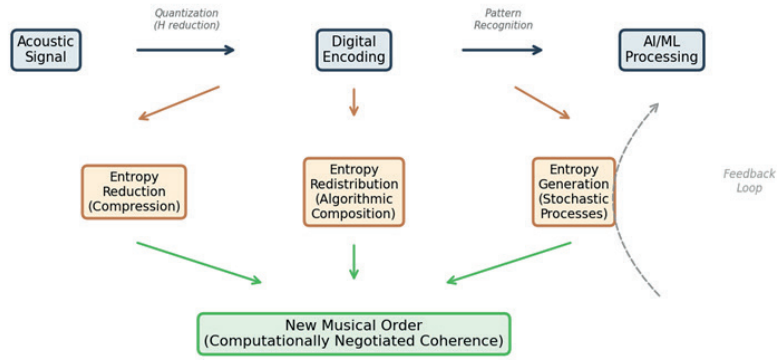

Figure 5. Conceptual model of technological entropy management. Digital technologies mediate entropy through encoding, redistribution, and generation, producing computationally negotiated musical coherence with iterative feedback.

6.6. Future Scenarios: AI, Neurotechnology, and Quantum Music

Brain–computer interfaces translating neural activity directly into sound bypass traditional notation, creating a direct channel between cognitive and acoustic entropy (Miranda, 2014). Quantum computing—operating on superpositions—suggests a fundamentally new musical entropy in which compositional elements exist in multiple states until the moment of performance (Kirke & Miranda, 2017). These developments underscore the central argument: entropy is not a problem to be solved but a resource to be managed.

7. Conclusion: The New Anatomy of Music

This chapter has argued that entropy provides a uniquely powerful framework for understanding musical transformation across cultures and centuries. The trajectory from Renaissance modal order through Baroque and Classical systematization to Romantic destabilization and twentieth-century dissolution describes an entropy curve that is not merely rising but complexly oscillating, as each generation discovers new strategies for managing the tension between predictability and surprise.

The modal traditions examined in Section 4 demonstrate that entropy management is universal in musical cognition, manifested in culturally specific but structurally analogous forms. The Turkish makam system's regulation of melodic entropy through seyir prescriptions and the Indian raga system's multi-parametric control reveal organizational logics achieving comparable coherence through fundamentally different means. The cross-cultural encounters documented—particularly the Turkish experience of harmonizing microtonal melodies—illustrate the entropy costs and creative possibilities of inter-systemic contact.

The technological developments examined in Section 6 suggest that the twenty-first century witnesses not entropy's ultimate triumph but the emergence of new tools—computational, neuroscientific, and potentially quantum—for recalibrating the order–chaos balance at previously inaccessible levels of precision. The 1/f scaling research suggests that the most aesthetically satisfying music occupies a specific entropy region—poised at the edge of chaos where complexity and coherence coexist.

The anatomy metaphor requires a final revision. The musical body of the twenty-first century is no longer the organic organism of Classical aesthetics; it is a cybernetic hybrid—its skeleton augmented by algorithmic scaffolding, its nervous system extended by neural networks, its circulation digitized into data streams. Yet the fundamental principle remains: it lives by managing entropy, sustaining the dynamic equilibrium between order and surprise that constitutes the essence of musical experience. As long as this principle

endures, the anatomy of music will continue to evolve—not toward maximum entropy, but toward ever-more-sophisticated articulation of the boundary between the known and the unknown.

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Chapter 7

PREDICTING STUDENT PERFORMANCE WITH DEEP LEARNING AND DECISION TREES: ARTIFICIAL INTELLIGENCE-BASED APPROACHES IN EDUCATION[1]

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1. Introduction

In the world of education, being able to predict future trends in student success is a critical tool for both creating opportunities for early intervention and designing individualized learning strategies. When student performance indicators are identified at an early stage, teachers or administrators can implement support systems for underperforming profiles, thereby preventing negative processes such as absenteeism, declining motivation, and academic difficulties from deepening. From this perspective, being able to predict a student's future exam scores or academic performance serves as a decision support system that enhances educational quality at the institutional level.

However, traditional methods—such as linear regression, basic statistical analysis methods, or classical machine learning techniques—often fail to adequately capture the complexity inherent in educational data, the interactions between features, and latent structures. Educational data typically includes many variables: demographic information, study habits, absenteeism, psychological scales, etc. The interactions between these variables can exhibit nonlinear behavior that defies linear models. Furthermore, in learning processes that change over time, the effect of some variables may evolve; classical methods may be limited in modeling this dynamism. This shortcoming becomes particularly apparent in large, heterogeneous, or high-dimensional datasets (Alsariera et al., 2022).

In recent years, artificial intelligence, particularly deep learning models, has attracted attention with the promise of powerful solutions to these challenges. The ability to learn hidden representations through multilayer neural networks, the capacity to model complex nonlinear relationships, and scalability with large datasets make deep learning an attractive option in the context of educational analytics. For example, the "GritNet" study presented an approach to predicting exam success using student activity sequences with a BLSTM-based model, demonstrating high success in early stages compared to classical logistic regression methods (Kim, Vizitei & Ganapathi, 2018). Another study tested mid-term student performance prediction for online courses using CNN and RNN-LSTM models; these methods were observed to outperform optimized classical machine learning methods on some datasets (Moubayed et al., 2024). Furthermore, the review titled "The Power of Deep Learning Techniques for Predicting Student" examined 46 studies conducted between 2019 and 2023 and emphasized that deep learning techniques perform well on complex educational data (Alnasyan et al., 2024). Nevertheless, machine learning-based studies still dominate the educational analytics literature. Many studies have predicted student success using classical methods such as decision trees, random forests, support vector machines, and multilayer perceptrons (MLP) (e.g., the study "Educational data mining: prediction of students' academic ...") (Yağcı, 2022).

These approaches typically produce dichotomous results such as "successful/unsuccessful" at the classification level or use static models that disregard the temporal dimension of the educational process. The advantages offered by deep learning, such as its representational learning capability, capacity to process sequential data, and power to capture complex interactions, have not yet been fully exploited. Therefore, the application of deep learning in education analytics is still limited, and there is a significant gap in this area.

In this study, we aim to predict exam scores based on multiple student variables from the Kaggle "Student Performance Factors" dataset. Our goal is to demonstrate performance comparable to classical methods using deep neural networks, interpret the variable importance of the model, and translate the results into meaningful insights for teachers and education administrators. Additionally, we objectively demonstrate the added value provided by deep models by comparing deep learning findings with a decision tree model structured using the same data and classification scheme. In this way, we aim to contribute to early warning systems, personalized learning processes, and data-driven decision-making mechanisms.

2. Literature Review

Educational Data Mining (EDM) and Learning Analytics (LA) are defined as two closely related fields that aim to understand and improve learning based on the collection, measurement, and analysis of data generated in educational environments; recent reviews indicate that these fields are rapidly maturing in terms of methods and scope, but that it is important to emphasize the conceptual distinctions between them as they are sometimes used interchangeably (Romero and Ventura, 2020). Traditional/machine learning methods such as logistic regression, decision trees, and support vector machines (SVM) have long been the most widely used approaches for predicting student performance in this literature; comprehensive reviews report both the dominance of these methods in classification tasks and the decision tree as the most frequently preferred model in many studies (Albreiki et al., 2021). Decision trees have been particularly favored in training data due to their interpretability and rule extraction advantages; a balance between performance and generalization has been achieved using pruning/post-pruning strategies with derivatives such as C4.5/CART. Along these lines, it has been reported that ID3/C4.5-based studies provide applicability and rule-based explanations in academic performance prediction, and that DT offers meaningful predictive power in different university samples (Adhatrao et al., 2013). However, the relative superiority of models such as SVM, RF, k-NN, and LR can vary across different datasets; for example, one study reported that SVM yielded the highest accuracy (Agyemang et al., 2024).

In recent years, deep learning approaches have emerged prominently due to their ability to capture complex and non-linear relationships: From the early stages, the BLSTM-based GritNet model has outperformed classical logistic regression in early predictions in online courses, while new CNN/LSTM-based architectures have also yielded strong results in MOOC and higher education contexts (Kim et al., 2018). Furthermore, recent review studies report that deep neural networks (DNNs) achieve high accuracy in predicting student performance; it has even been shown that converting numerical 1D educational data into a 2D representation and using a hybrid 2D-CNN can outperform classical baselines (k-NN, NB, DT, LR) (Alnasyan et al., 2024).

However, significant gaps remain in the literature: (i) the risk of overfitting is high in small datasets, leading to generalization problems in deep learning applications; therefore, measures such as regularization/data augmentation are emphasized, (ii) model interpretability is critical for decision-makers in an educational context, and a more systematic integration of XAI approaches is noted as necessary, (iii) methodological errors and evaluation biases are still observable in applied studies (Safonova et al., 2023).

Building on this body of knowledge, this study aims to demonstrate the effectiveness of deep learning in predicting exam scores using Kaggle's "Student Performance Factors" dataset and to transform the resulting predictions into a practical decision support framework for education administrators and teachers.

3. Method

In this study, a methodological framework for predicting student performance was designed in three stages based on the Kaggle "Student Performance Factors" dataset (Kaggle, 2025). First, the dataset consists of student grades (midterm/assignment/quiz and final exam scores), demographic indicators (age, gender, etc.), interaction records obtained from the learning management system (LMS) (number of sessions, content viewing, assignment submission times), course attendance/absenteeism rates, and behavioral traces related to the process. Studies with large samples have shown that LMS-derived logs can be used to predict student success at an early stage; therefore, LMS records were also included in the scope of the study (Riestra-González et al., 2021). Data preprocessing was applied in the second stage: (i) missing values were imputed using appropriate statistics according to the variable type and distribution, (ii) continuous variables were normalized/standardized to stabilize the training of neural networks; normalization has been previously reported to have significant effects on the performance of artificial neural networks, (iii) categorical variables were converted to numerical representations using one-hot encoding (Asif et al., 2020). The literature emphasizes that appropriate scaling and representation in deep learning applications directly affect model

performance; moreover, regularization techniques are critical for reducing overfitting. In this context, dropout has been used (Srivastava et al., 2014).

In the modeling layer, regression was established using a multi-layer perceptron (MLP) as the basic architecture; hybrid CNN+LSTM/GRU designs utilizing recurrent structures such as LSTM and GRU for scenarios involving sequential/event-based features and CNN layers for local pattern extraction were evaluated. This choice is consistent with recent studies reporting the superiority of deep architectures in capturing nonlinear relationships and temporal dependencies in training data (e.g., BLSTM-based GritNet and CNN-LSTM-type approaches) (Kim et al., 2018). In hyperparameter tuning, parameters such as learning rate, layer/width, epoch count, dropout rate, and batch size were scanned using grid/random search; dropout was used to reduce overfitting, and computationally efficient Adam was preferred for optimization (Adam, 2014). In the training setup, data was split randomly into 70% training and 30% testing with a fixed seed for reproducibility; tuning and early stopping decisions were made using a validation slice allocated within the training portion. This deep learning-based end-to-end design aims to achieve accuracy gains reported in predictive problems in education (e.g., BLSTM-based early success prediction) while balancing the risk of overfitting through regularization and careful discrimination strategies (Kim et al., 2018).

For comparative analysis, a decision tree (DT)-based regression model was also constructed while maintaining the same data and classification scheme. DT is a flexible, interpretable method capable of handling continuous and categorical attributes, which can be expanded using binary splits and pruning strategies to improve generalization; The pruning approach on the CART line and weakest-link pruning applications provide a standard reference framework for this purpose (Breiman et al., 2017). This allows the accuracy/calibration gains provided by DL architectures to be objectively compared with a rule-based and interpretable baseline model.

4. Results

This section presents tables and figures showing the performance metrics of deep learning and decision tree models on the test set created with a 70–30 split, along with randomly selected true–predicted pairs from the test.

Table 1. *Deep learning and decision tree model performance metrics*

Metric	Metric Code	DL-Value (Mean ± SD)	DT- Value (Mean ± SD)
Root Mean Square Error	RMSE	**1.924 ± 0.000**	**3.052 ± 0.000**
Mean Absolute Error	MAE	**0.534 ± 1.848**	**1.688 ± 2.543**
Relative Error	—	**0.74% ± 2.05%**	**2.47% ± 3.38%**
Mean Square Error	MSE	**3.701 ± 45.808**	**9.315 ± 57.165**
Pearson Correlation	r	**0.868**	**0.672**
Coefficient of Determination	R^2	**0.753**	**0.451**
Kendall Rank Correlation	τ	**0.926**	**0.669**

When Table 1 is evaluated, it is seen that the deep learning model offers high accuracy and better calibration: For DL, r=0.868, R^2=0.753, RMSE=1.924, MAE=0.534, and Kendall's τ=0.926; in contrast, for the decision tree, r=0.672, R^2=0.451, RMSE=3.052, MAE=1.688, and τ=0.669 are reported. The relative error of DL is ≈0.74%, while that of DT is 2.47%, indicating that DL has a clear advantage in terms of both absolute error (RMSE/MAE) and rank consistency (τ). On the other hand, some areas of uncertainty are noteworthy: in the DL table, RMSE is ±0.000, while MSE is ±45.808 and MAE is ±1.848; in the DT table, RMSE is ±0.000, while MSE is ±57.165 and MAE is ±2.543. Overall, the findings reveal that DL is more successful than DT in terms of both absolute error and capturing the trend.

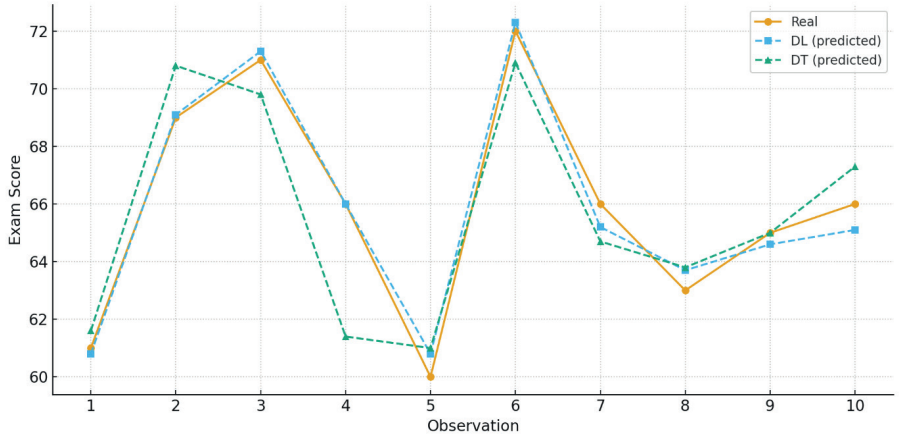

Figure 1. *Actual vs Predicted Exam Scores (10 Random Test Samples)*

Figure 1 compares the exam scores predicted by Deep Learning (DL) and Decision Tree (DT) models using 10 randomly selected observations. In general, both prediction models capture the trend of the actual values, but more fluctuation (variance) is observed in the DT model's predictions. The DL

model, on the other hand, exhibits more stable performance and draws a more reliable prediction profile by following a trajectory closer to the actual values. This indicates that the generalization performance of the DL model may be higher than that of the DT for this particular dataset.

5. Discussion

The accuracy and calibration findings obtained in this study are consistent with the gains offered by deep learning in predicting student performance. It has been reported that LSTM-based approaches excel in capturing sequential/interactive learning traces, and that Deep Knowledge Tracing can accurately predict future performance based on a student's past interactions; these results indicate that deep architectures can learn complex patterns that traditional methods based on linear assumptions may miss. In contrast, decision trees (and tree-based ensembles) are seen as both common and powerful baselines in the literature; numerous review and comparison studies report that the DT/Random Forest/GBDT family delivers competitive or superior performance in most scenarios on training data and offers interpretability advantages. In this context, the fact that DT closely follows real scores in the 60–72 range in our sample and appears consistent, with minor systematic deviations, is in line with the aforementioned literature (Aksu and Dogan, 2019).

The practical implication of the predictive power obtained is early warning systems and personalized learning designs: determining the risk of failure/dropout weeks in advance using in-term interaction data enables timely triggering of counseling and support interventions. Here, the transparency offered by DT's branching rules facilitates the justification of decisions by counselors and teaching staff thanks to its risk threshold, feature paths, and capacity to produce answers to the "why" question. Indeed, tree-based and explainable pipelines in early warning applications have been shown to provide operational benefits to institutions in terms of both performance and actionability (Pei, B., & Xing, 2022).

Furthermore, in terms of methodological positioning, our findings align with recent evidence that tree-based ensembles offer robust baseline performance in practice, largely due to the tabular nature of educational data. The literature reports that deep learning does not always prevail in similar feature spaces; specifically, for well-organized tabular data, the Gradient Boosting/Random Forest family often delivers competitive or superior performance. Therefore, complementary (hybrid/stacking) setups, where sequential interaction signals can be captured with DL and static/summary attributes with DT/GBDT, emerge as an advantageous approach in terms of accuracy and robustness in field applications. Indeed, close examination shows that Random Forest and its derivatives are widely and effectively used in early warning/success prediction in higher education (Oyedotun et al., 2025).

In this regard, the explainability dimension is a critical threshold for internal implementation and stakeholder trust. The ability of tree-based models to generate local-global explanations using methods such as SHAP provides concrete answers to risk thresholds and "why" questions, facilitating intervention design for advisors and faculty; it strengthens the policy/practice dialogue through decision paths and feature contributions. Indeed, explainability frameworks developed for tree models and CatBoost-SHAP-based early warning examples offer applicability in terms of both predictive power and actionable transparency. In this regard, our study shows that closely monitoring the real scores of DT is consistent not only with accuracy but also with operational explainability and accountability (Sohail, 2022).

The main limitations of this study are that, despite the high performance of the deep learning model, its complex structure means it remains a "black box" and is not directly interpretable for training stakeholders; and finally, the exam score, which is the ultimate measure of the model's success, may not be a comprehensive indicator of the learning process alone..

6. Conclusions

The results of this study reveal that the deep learning model demonstrated higher accuracy, lower error, and better generalization performance compared to the decision tree model in the task of predicting student performance. The findings confirm the superior capacity of deep learning to model complex and non-linear relationships in educational data. As a practical implication, this deep learning-based approach may enable the development of effective early warning systems and personalized learning interventions for educational institutions. However, the interpretability advantage offered by decision tree models should not be overlooked. Therefore, future studies are recommended to develop hybrid approaches that combine the predictive power of deep learning with the transparency of tree-based models. Furthermore, another important recommendation is to improve institutional data infrastructures to ensure the integration of models into a real educational environment and to design tools that enable teachers and decision-makers to interpret model outputs. Finally, testing similar models in different educational contexts and on larger datasets would be beneficial for understanding their generalizability.

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