

# The Classroom as a Dynamic System: The Role of Adaptive Leadership in Shaping Habituation

Corina VEDEANU<sup>1</sup>, Ion STEGĂROIU<sup>2</sup>

<sup>1</sup> Valahia University of Târgoviște, Aleea Sinaia Street, 130004, Târgoviște, Romania;  [ORCID No. 0009-0009-5228-714X](https://orcid.org/0009-0009-5228-714X); [vedeanucorina@yahoo.com](mailto:vedeanucorina@yahoo.com) (corresponding author)

<sup>2</sup> Valahia University of Târgoviște, Aleea Sinaia Street, 130004, Târgoviște, Romania; Academy of Romanian Scientists, Ilfov Street 3, 050094 Bucharest, Romania; [ORCID No. 0009-0008-5946-2601](https://orcid.org/0009-0008-5946-2601); [stegaroiuion@yahoo.com](mailto:stegaroiuion@yahoo.com)

Received: April 6, 2026

Revised: May 13, 2026

Accepted: May 25, 2026

Published: June 30, 2026

**Abstract:** In classroom environments, learning is not merely an individual cognitive process, but it emerges from complex interactions within dynamic social systems. This paper conceptualizes the classroom as a self-organizing system in which adaptive leadership plays a central role in shaping patterns of interaction, stability, and learning. Drawing inspiration from natural systems, the paper argues that order in the classroom emerges through guided regulation rather than imposed control. Adaptive leadership contributes to the reduction of entropy by structuring interactions, modeling appropriate responses, and creating conditions for collective habituation. Emotional, social, and metaphorical intelligence influences how students act, react, and interact to classroom experiences. The central concept introduced is classroom habituation, defined as a collective process through which repeated interactions gradually stabilize into shared patterns of behavior, emotion, and meaning. Habituation is thus understood as a key mechanism for transforming classroom variability into functional order. By integrating entropy, habituation, and adaptive leadership, the study proposes a conceptual framework that explains how distinct classroom climates and learning conditions emerge over time. To explore these relationships, the study employs a quantitative design based on parallel questionnaires distributed to teachers and students, in order to examine leadership practices, classroom entropy, habituation processes, and learning outcomes.

**Keywords:** Adaptive Leadership, Classroom Habituation, Classroom Entropy, Emotional and Social Intelligence.

## Introduction

“Learning occurs between a fear and a need.” (Kofman & Senge, 1993, p. 14). And the most important learning in contemporary organizations is to gain shared insight into complexity in order to shape change (Senge, 1999), since change and innovation are non-linear (Knight, 2021). Challenges force organizations to clarify their values, to develop new strategies, and to learn new ways of operating (Heifetz et Laurie, 1997). It is not easy to lead an organization to adapt to changes (Heifetz et al., 2009), hence leaders have the responsibility to overcome challenges and to implement change (Issah, 2018). In this context, learning and leadership become connected, especially in environments characterized by uncertainty, adaption, and continuous transformation. Schools are among such environments exposed to change. In school, students learn that “the name of the game is not learning, but performing” (Senge, 1999, p. 39). Since learning is a consequence of teaching (Knight, 2021), a teacher leader must create an environment based on commitment, care, and innovation. Within these dynamic systems, the role of the teacher goes beyond instruction, involving continuous regulation of interactions and responses. Leadership has to take place every day (Heifetz & Laurie, 1997), and teachers are the most suited to assume leadership roles because they interact with students daily (Soares, 2020).

## How to cite

Stegăroi, I., Nistorescu, G.G., & Nistorescu, M.A. (2026). Management in Atypical Organizations: Differences Between Military-type and Classical Management Models. *Journal of Knowledge Dynamics*, Vol. 3. No. 1 pp.78-90. <https://doi.org/10.56082/jkd.2026.1.78> ISSN ONLINE 3061-2640

In educational settings, there is still a traditional perspective of learning as being linear, although adaptive problems are often systemic and have no ready answers (Heifetz & Laurie, 1997). There is a tendency to fragment problems into isolated parts, although many of the challenges we face are systemic in nature (Kofman & Senge, 1993). However, when classrooms are examined from the perspective of complex adaptive systems, teachers gain valuable insights about learning (Knight, 2021). Schools are neither linear nor closed systems. As complex learning systems, they are far more organic and dynamic than traditional models suggest (Marshall, 1996). Adaptive leadership provides a framework for understanding how teachers respond to classroom variability, while shaping patterns of engagement, behavior, and learning. Adaptive leaders hold a holistic vision, being able to see the various possibilities in order to make appropriate choices (Bratianu & Lefter, 2001; Glover et al., 2002).

Heifetz and Laurie argue that leaders should give a voice to everybody (Heifetz & Laurie, 1997). This principle becomes particularly relevant in classrooms, where multiple individuals continuously influence one another. Classrooms display many characteristics associated with complex adaptive systems, and when organized according to similar principles, they could maximize knowledge sharing and collective learning among students. Complex adaptive systems contain multiple agents and cannot be explained using traditional scientific methods. They adapt through complex processes of emergence (Knight, 2021), become communities of inquiry, as their components are engaged in making new meaning together (Kennedy & Kennedy, 2010; Ahmad et al., 2021).

Learning within such systems is not only about instructional practices. It also depends on emotional climate, social interaction, and the meaning that students construct around their experiences. Without interaction, a classroom would be a lifeless system (Vetromille-Castro, 2013). The network of interactions results in an extremely complex system (Mallows, 2002), and experienced teachers have implicit knowledge of the classroom's demands, tailoring activities that involve students (Doyle, 1986). Besides logical reasoning, learning also requires a combination of affective climate, social interaction, and symbolic dimensions. As shown by Vedeanu and Stegăroiu (2025), emotional intelligence (EI), social intelligence (SI), and metaphorical intelligence (MI) can be understood as pillars that support human cognition and development. EI allows teachers to recognize and regulate emotional fluctuations, SI enables them to navigate relationships and group dynamics, while MI can bring meaning and understanding to learning experiences (Vedeanu & Stegăroiu, 2025).

Within classroom environments understood as dynamic systems, teachers play a vital role in guiding interaction patterns. They adjust their practices to the needs of the group, going beyond instruction or management and continuously shaping classroom dynamics (Kennedy & Kennedy, 2010). By reducing variability and managing interaction patterns, adaptive teachers contribute to the stabilization of the classroom, creating conditions for both habituation and learning. Adaptive leadership does not explain what a teacher does, but mostly how a classroom interacts, regulates, and stabilizes, in order to foster learning. Classrooms do not evolve toward uniformity. Their climate is a multidimensional construct (Wang et al., 2020) and their interactions form a complex system (Mallows, 2002), so even under similar structural conditions, identical curricula, and the same teachers, each classroom develops distinct configuration shaped by ongoing interactions and habituation processes. Classroom entropy refers to the degree of variability, unpredictability, and instability in the patterns within the classroom. The habituation processes transform fluctuating classroom dynamics into relatively stable configurations, through the guidance of adaptive leadership. As a result, each classroom becomes unique, an adaptive system characterized by its own entropic signature.

Previous studies (Hawkins & Kandel, 1984; Rankin et al., 2009; Typlt, 2013; Schmid et al., 2015) have shown that habituation is traditionally studied at the individual level, particularly in simple organisms, being considered the simplest form of learning.

Nevertheless, similar patterns of response can be observed in classroom settings. Unlike biological systems, classroom habituation emerges through social interaction and it is shaped by adaptive leadership. This paper extends the concept of habituation by metaphorically proposing it as a collective process occurring within the classroom. In the natural world, habituation is a passive reduction of responses to repeated stimuli (Hawkins & Kandel, 1984; Rankin et al., 2009; Typlt, 2013). In the classroom, it can become a pedagogical mechanism shaped by adaptive leadership, allowing entropy to stabilize and creating conditions that foster learning.

## **Literature Review**

### ***Education and the classroom as a complex adaptive system***

According to Knight, education is not a morally neutral activity, but a purposeful one. It exists so that people learn something, not anything, as one of the educational aims is to make a difference (Knight, 2021). There is a lack of vision regarding what is truly needed in the classroom (Senge, 1999). As complex learning systems, schools are far more organic and dynamic than linear (Marshall, 1996). Unpredictability, non-linearity, and self-organization add to the classroom's features, since there are random behaviors that cannot be foreseen and these systems are constantly struggling to absorb new behavior and elements (Vetromille-Castro, 2013). Groups of individuals in learning contexts can be seen as complex adaptive systems (CAS), where interaction is essential for knowledge construction (Grisogono & Radenovic, 2011; Vetromille-Castro, 2013). Without interaction, a classroom would be a lifeless system (Vetromille-Castro, 2013). Since classrooms function as CAS, inter-relationships create networked and non-linear behaviors from which change, meaning learning, emerges at different levels. Despite this, teachers still exercise control, instead of becoming more attuned to the collective (Knight, 2021).

Previous studies (Vetromille-Castro, 2013) have shown that a classroom becomes a living organism, trying to harmonize diversity and to adapt to external changes. Classroom climate is a complex multidimensional construct (Wang et al., 2020) and classroom life has an intrinsic rhythm (Doyle, 1986). In addition, classroom management has the most direct impact on students' achievement, as it creates a safe and stimulating learning environment (Djigic & Stojiljković, 2011). When their needs are met, students are more likely to engage in learning and to develop academic skills (Wang et al., 2020). Efficient lesson planning and effective classroom management are both necessary in order for learning to take place (Martin & Baldwin, 1993). Students' achievements improve when teachers practice the interactionist style and decrease when teachers are interventionists (Djigic & Stojiljković, 2011). The presence of the teacher improves learning by mechanisms of relational dynamics (De Felice et al., 2022), since teachers build the school's capacity to improve (Chan, 2019). Teacher leadership is a sleeping giant that can become a catalyst for implementing changes to improve learning (Katzenmeyer & Moller, 2011). With the teacher as a facilitator of the educational environment, the classroom becomes an open system, where individuals strive to construct knowledge together (Ahmad et al., 2021).

According to Doyle (as cited in Djigic & Stojiljković, 2011), the classroom is a complex environment, where events happen fast, in an unpredictable way, and the teacher is always on stage. Classrooms can be defined as communities of inquiry since they are open systems, whose components are engaged in making new meaning together (Kennedy & Kennedy, 2010; Ahmad et al., 2021). As a result, classrooms cannot be understood or classified as static structures, but rather as evolving systems in which order and disorder coexist, along with variability and invariability. "Context plays a pivotal role in shaping the leadership practices that contribute to school efficiency." (Dagala et al., 2024, p. 365). Likewise, effective leaders respond to the changing needs of the context (Hallinger, 2003, p. 346). In contexts characterized by unpredictability, adaptive leadership contributes to the reduction of entropy by structuring interactions and guiding students toward more

stable patterns of response. Thus, it facilitates habituation processes, enabling students to filter irrelevant stimuli and regulate their emotional and behavioral responses.

### ***Adaptive leadership in educational systems***

Because schools operate as dynamic systems, leadership becomes essential for responding to complexity and change. Principals need to create a purposeful community, in order to respond to the demands for change (Squires, 2015). School should nurture and deepen the love for learning. Also, school should help students develop new skills of systemic thinking, teaching them how to learn, especially together (Senge, 1999). Systems thinking is essential for change, although it can also be uncomfortable (Senge et al., 2007). We resist change and keep the belief that only the top can initiate significant change, because we don't want to give up a familiar mental model (Senge, 1996). Furthermore, change creates a situation filled with anxiety and uncertainty (Issah, 2018), whereas adaptive change is distressing for those going through it (Heifetz et Laurie, 1997).

Mujari, Astuti, and Surya (2026) argue that the key elements of adaptive leadership, such as the holding environment, the disciplined attention or emotional intelligence are closely related to teachers' pedagogical competence and performance (Mujari et al., 2026). Its goal is to energize and motivate through shared values and purposes (Squires, 2015). Adaptive leadership is about change (Heifetz et al., 2009) and adaptive approaches are needed as a response to uncertainty (Dunn, 2020). Today's most pressing societal issues will not be solved through hierarchical authority (Senge, 1996). Community builders are predisposed to creating change and significant change requires imagination, dialogue and deep caring (Senge, 1996). An organization doesn't need change because it is broken (Heifetz et al., 2009a). It is challenging to determine it to adapt to changes and approaches that worked in the past may no longer be appropriate (Heifetz et al., 2009b). As humans, we have always faced challenges, although we are often our worst enemies regarding change (Helterbran, 2016). Adapting to challenges involves creative problem solving and it goes beyond learning, requiring a holistic perspective (Glover et al., 2002). Adaptive leaders have this holistic vision, being able to see the various possibilities in order to make the best choices (Glover et al., 2002). Adaptive leadership emphasizes flexibility and innovation, continuous learning and collaboration (Squires, 2015; Mujari et al., 2026). It involves changing behavior in appropriate ways as the situation changes (Yukl & Mahsud, 2010). Adaptive leaders think globally, but act locally (Glover et al., 2002), they mobilize people to cope with challenges and to thrive (Heifetz et al., 2009b; Good et al., 2021).

Vetromille-Castro (2013) stated that the classroom's non-linearity is a conflict between teaching and learning. According to Piaget (as cited in Glover et al., 2002), learning by assimilation is an additive process, while learning by accommodation is an experiential one, allowing the learner to adapt to a changing world. Thus, adaptive leadership requires organizations to use assimilation and to be willing to accommodate. Openness to learning means accepting the possibility of being wrong and letting go of having to be right (Grisogono & Radenovic, 2011). The quality of learning depends on the condition of infrastructure, human and material resources (Valerio, 2012; Ahmad et al., 2021), since learning is based on social interactions (De Felice et al., 2022). Complex systems are adaptive, non-linear, and interactive, their behavior emerging from the interaction of its components (Larsen-Freeman, 1997; Mallows, 2002; Cameron & Larsen-Freeman, 2007). Any complex system embraces change and focuses on it (Cameron & Larsen-Freeman, 2007). In an educational setting, leadership at its best is perceived in the interactions between people and the situations they face (Helterbran, 2016). In order to achieve academic performance, school leaders may need to develop an adaptive approach, experiencing what solutions work within their unique school context (Dunn, 2020).

Vedeanu and Stegăroiu (2025) showed that there are three dimensions playing a significant role in how classroom interactions are regulated and transformed into meaningful experiences. They are integrated into the triad of intelligences consisting of emotional intelligence (EI), social intelligence (SI), and metaphorical intelligence (MI). They provide mechanisms through which adaptive leadership may influence classroom

dynamics. EI contributes to emotional safety and students' ability to engage in learning processes, SI supports collaboration and group interaction, while MI allows both learners and teachers to organize complex experiences into shared interpretations (Vedeanu and Stegăroiu, 2025).

CAS are based on an intertwined network of constant interactions, generating patterns that are often unpredictable and difficult to control (Knight, 2021). As interactions multiply, variability naturally emerges within the system. This variability can be understood through the concept of entropy. According to Bratianu and Bejinaru (2019), entropy was originally associated with thermodynamics and it refers to the tendency of the systems to move toward increasing disorder (Bratianu & Bejinaru, 2019). In educational environments, entropy would rather reflect the degrees of variability and unpredictability present within interactions, as classrooms consist of multiple individuals influencing one another. Within open systems, external energy is constantly integrated, slowing entropy down (Vetromille-Castro, 2013).

### ***Classroom entropy and classroom order***

The term entropy was coined in 1865 by the German mathematician and physicist Rudolf Clausius (Vetromille-Castro, 2013; Bratianu & Bejinaru, 2019). Originally related to energy dissipated in the process (Vetromille-Castro, 2013), entropy has since been applied to social and organizational systems. Bratianu and Bejinaru (2009) argue that the main attribute of energy is the fact that it is a field, "a continuum of forces" within a social context (Bratianu & Bejinaru, 2019, p. 3). Entropy is also present in CAS (Vetromille-Castro, 2013). Organizations create both order and disorder, they produce both entropy, seen as the degradation of the system and of itself, and negentropy, the regeneration and renewal (Morin, 1992).

In educational settings, entropy has been explored as a means of understanding the dynamics of pedagogical systems (Dunn, 2020). Students learn more when there is less confusion and misbehavior and more productive work (Doyle, 1986). When entropy is low, the realization of potential is high (Ahmad et al., 2021), while a high level of disorder implies a high level of entropy (Bratianu & Bejinaru, 2019). Disorder is distractive (Csíkszentmihályi, 1990), which explains why teachers often rely on routines to reduce confusion in the classroom, since classroom order rests fundamentally on familiar activities that ensure stability and continuity (Doyle, 1986). Thus, as shown by Bratianu & Bejinaru, knowledge sharing can reduce entropy, because energy is distributed efficiently, rather than equally, fostering innovation and learning (Bratianu & Bejinaru, 2019).

Learning itself can be viewed as a local anti-entropic process (Ahmad et al., 2021), since open systems evolve and increase in order and complexity by absorbing energy from the environment (Larsen-Freeman, 1997). According to Norbert Wiener (as cited in Ahmad et al., 2021) social systems create local order in a universe that naturally tends toward disorder. Flow, also known as negentropy, represents a source of energy that educators seek to harness in order to foster learning (Csíkszentmihályi, 2014).

### ***Habituation as a mechanism of classroom stabilization and learning***

The concept of habituation originates from the work of Eric Kandel and his studies on the marine snail *Aplysia* (Hawkins & Kandel, 1984; Kandel & Hawkins, 1992; Kapoukranidou et al., 2009). With approximately 20.000 nerves cells, *Aplysia* provided a model through which habituation was identified as one of the simplest forms of leaning (Hawkins & Kandel, 1984; Rankin et al., 2009; Typlt, 2013; Schmid et al., 2015). Habituation occurs when an organism learns to ignore a weak stimulus that is repeatedly present and neither dangerous nor rewarding (Hawkins & Kandel, 1984; Rankin et al., 2009; Typlt, 2013). Learning involves the acquisition of knowledge and skills, while memory refers to the ability to store and maintain them (Kandel & Hawkins, 1992; Kapoukranidou et al., 2009). Learning changes both the function and the structure of the central nervous system

(Hawkins & Kandel, 1984; Kandel & Hawkins, 1992; Kapoukranidou et al., 2009). In educational environments, learning is a form of social progress (Kandel & Hawkins, 1992) and it can be understood as a process of establishing connections and acquiring information from the networks (Shi & Liu, 2025) where teacher leaders serve as facilitators of learning and teaching (Issah, 2018).

Although habituation has traditionally been studied at an individual level, its logic can be extended to classroom settings. Through repeated interactions, students learn to filter irrelevant stimuli, adapt to routines, regulate emotional responses, and focus attention on learning tasks. Repetition gradually transforms uncertainty into familiarity, allowing classroom interactions to stabilize into patterns of behavior and participation. The relationship between learning, emotion and body is connected to the notion of learning itself (Immordino-Yang & Damasio, 2007). Sometimes, learning is not about what teachers do. It is filtered through a range of networked factors (Knight, 2021) where each structure evolves through interactions (Kofman & Senge, 1993). In a classroom, learning takes place not only as intended by the structures of the organized schooling, the curricula or the teachers, but it becomes behavioral, relational, and environmental (Knight, 2021), so that students learn within a space of active learning and meaning (Daniels, 2010). From this perspective, classroom habituation can be understood as a collective process through which teachers transform variability into functional order.

Learning is fundamentally embedded in social interactions (De Felice et al., 2022). It is a process of acquiring information and constructing connections within networks (Shi & Liu, 2025), where teacher leaders serve as facilitators of learning and teaching (Issah, 2018). The quality of learning depends on infrastructure, human resources, and material conditions (Valerio, 2012; Ahmad et al., 2021), but also on the social interactions that occur within educational environments (De Felice et al., 2022). Efficient lesson planning and effective classroom management are necessary for learning to take place (Martin & Baldwin, 1993). When students' needs are met, they are more likely to engage in learning and develop academic skills (Wang et al., 2020). Research suggests that achievement improves when teachers adopt interactionist approaches and declines when teaching becomes mainly interventionist (Djigic & Stojiljković, 2011). When the challenge is higher than the skills, anxiety results (Csíkszentmihályi, 1990; Csíkszentmihályi, 2014). Adaptation implies a fundamental change in how we see the world, forcing us to rethink the very notions of leadership and organizations (Glover et al., 2002). It is a natural process for dealing with complex situations (Grisogono & Radenovic, 2011), taking time and relying on diversity (Heifetz et al., 2009b). Many forms of learning are associative in nature, as individuals learn to connect different stimuli and experiences over time (Kapoukranidou et al., 2009).

As noted by Lieberman, 2013, "When people feel better, they perform better." (Lieberman, 2013, p. 3). Learning organizations are generally more adaptive than traditional organizations, they cultivate empathy, compassion, and the capacity to function as systems (Kofman & Senge, 1993). Individual minds become interconnected within larger social systems, and effective leaders understand how to improve interconnectedness (Lieberman, 2013). In education, the teacher's presence enhances learning through relational dynamics (De Felice et al., 2022). Teachers build the school's capacity for improvement (Chan, 2019) and teacher leadership has been described as a sleeping giant capable of catalysing meaningful educational change (Katzenmeyer & Moller, 2011). As facilitators of the educational environment and managers of learning, teachers contribute to the creation of open learning systems in which knowledge is constructed collectively (Ahmad et al., 2021).

Classrooms are not static. They should be understood as dynamic social systems, in which learning depends on the ongoing interactions that occur within educational environments (De Felice et al., 2022). Entropy could represent the natural variability and unpredictability of the classroom life, since it is used as a means of understanding the dynamics of pedagogical systems (Dunn, 2020). There is an invisible thread connecting entropy, habituation, and learning within the classroom environment, represented by

adaptive leadership, an educational tool that does not eliminate variability, but channels it into repeated and meaningful interactions.

### Methodology

This study employed a quantitative questionnaire to explore the relationships among adaptive leadership, classroom entropy, classroom habituation, and learning outcomes. Participants consisted of 42 teachers and 68 students from Romania lower-secondary and upper-secondary education. Among the teachers, 66,7% taught at the lower-secondary level and 33,3% at the upper-secondary level. The student sample included 70,6% lower-secondary students (grades V-VIII) and 29,4% upper-secondary students (grades IX-XII) with a gender distribution of 41 females and 27 males.

Data were collected using two parallel questionnaires designed in a mirror structure, one addressed to teachers and one to students. Both questionnaires contained 16 items on a five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). The items were organized into four conceptual dimensions: adaptive leadership (items 1-4), classroom entropy (items 5-8), classroom habituation (items 9-12), and learning outcomes (items 13-16).

Adaptive leadership referred to teachers' perceived capacity to adjust instructional and pedagogical strategies, communication, and feedback according to situations in the classroom and to students' needs. Classroom entropy described fluctuations in attention, behavioral responses, and interaction patterns. In the Results section, it is used the term classroom dynamics, in order to capture the ongoing interactions among students. Classroom habituation represented the gradual formation of stable routines and behavioral expectations through repeated classroom experiences. Learning outcomes referred to students' understanding, participation, and sense of educational safety.

### Results and Discussions

The aim of this article was to examine how adaptive leadership, classroom entropy, classroom habituation, and learning outcomes are perceived by teachers and students. It was assumed that learning emerges through the interaction of all these elements, since classrooms operate as dynamic open systems, characterized by ongoing interactions, feedback, and adaptation. From this perspective, classroom stability is not viewed as a fixed condition but as an emergent property that develops gradually through repeated social and instructional interactions. Adaptive teachers are supposed to regulate classroom dynamics, in order to stabilize entropy, metaphorically seen as the natural variability inherent in classroom life. It reflects fluctuations in students' participation, attention, and social interactions. From this perspective, entropy requires continuous regulation through adaptive leadership and collective habituation.

**Table 1. Students' Descriptive Statistics by Dimension (N-68)**

Dimension	Mean
Adaptive Leadership	3.83
Classroom Dynamics	3.38
Habituation	3.61
Learning Outcomes	3.93

Source: authors' research

The findings suggest that students generally perceive their teachers as adaptive and responsive to the classroom's needs. The highest scores obtained for learning outcomes indicate that students experience positive effects in terms of participation, understanding, and safety. The lower scores for classroom dynamics reflect the presence of variability and fluctuations within classroom interactions. The highest mean scores were obtained from the items related to adaptation and repetitive activities (4.25), safety when learning (4.09), and the teacher's communication depending on the situation (4.07). Together,

these findings suggest that adaptive leadership may contribute to the development of stable and supportive learning environments, guiding both interaction and learning in the classroom.

**Table 2. Gender differences**

Dimension	Female Students	Male Students
Dimension	3.66	4.09
Adaptive Leadership	3.51	3.18
Classroom Dynamics	3.53	3.72
Habituation	3.53	3.72
Learning Outcomes	3.77	4.17

Source: authors' research

Male students reported higher perception of adaptive leadership, habituation, and learning outcomes than female students. In contrast, female students perceived a higher degree of classroom variability and fluctuations. These differences could indicate distinct ways of interpreting classroom experiences and suggest that gender-related factors may influence perceptions of classroom functioning.

**Table 3. Differences by Educational Level**

Dimension	Grades V-VIII	Grades IX-XII
Adaptive Leadership	3.78	3.96
Classroom Dynamics	3.42	3.28
Habituation	3.49	3.89
Learning Outcomes	3.92	3.95

Source: authors' research

Students from upper secondary education reported higher levels of adaptive leadership and habituation than students from lower secondary education. This finding may suggest that repeated interactions over time contribute to the stabilization of classroom routines and behavioral patterns. Also, older students internalize differently pedagogical practices. Learning outcomes remained relatively high across both educational levels, indicating that students generally perceive the classroom as supportive of learning.

Overall, the results support the view of the classroom as a dynamic system in which adaptive teacher behaviors contribute to the emergence of stable interaction patterns and positive learning experiences. Students generally perceived their teachers as adaptive and responsive, suggesting that leadership in the classroom settings may function as a regulatory mechanism that helps manage interactions and reduce uncertainty. Repeated classroom experiences stabilize into patterns of behavior and participation, as students become more involved in the activities proposed by the teachers. Habituation appears to function as a bridge between classroom variability and academic outcomes, transforming repeated experiences into a mechanism that stabilizes entropy in order to facilitate learning. At the same time, the scores obtained for learning outcomes and psychological safety suggest that adaptive leadership can contribute not only to instructional effectiveness but also to the emotional climate of the classroom.

**Table 4. Teachers' Descriptive Statistics (N= 42)**

Dimension	Mean
Adaptive Leadership	4.48
Classroom Dynamics	3.85
Habituation	3.44
Learning Outcomes	3.76

Source: authors' research

Teachers reported very high levels of adaptive leadership, suggesting they perceive themselves as highly responsive to students' needs and classroom dynamics. They frequently experience variability, fluctuations in attention, and diverse student responses. Habituation obtained a moderate score, while learning outcomes remained relatively high, suggesting that despite classroom variability, teachers perceive learning processes as generally effective, despite the interruptions in students' attention.

**Table 5. Comparison between Teachers and Students**

Dimension	Teachers	Students
Adaptive Leadership	4.48	3.83
Classroom Dynamics	3.85	3.38
Habituation	3.44	3.61
Learning Outcomes	3.76	3.93

Source: authors' research

Teachers evaluate their adaptive leadership more positively than students, which suggests that teachers perceive themselves as highly adaptive, while students recognize this adaptability to a lesser degree. Also, teachers report higher levels of classroom dynamics and variability. This finding is important because it indicates that teachers are more aware of the complexity, unpredictability, and fluctuating nature of classroom interactions. One possible explanation is that students may become habituated to the everyday variability of classroom life and therefore perceive certain fluctuations as normal. As a result, teachers may be more sensitive to these changes in attention, participation and organization than students themselves. Finally, students report slightly higher learning outcomes, indicating that the educational environment may have a stronger positive impact on learners than teachers estimate.

**Table 6. Teachers' Comparison by Educational Level**

Dimension	Lower Secondary	Upper Secondary
Adaptive Leadership	4.55	4.32
Classroom Dynamics	3.90	3.75
Habituation	3.50	3.32
Learning Outcomes	3.82	3.62

Source: authors' research

Lower secondary education teachers reported higher scores across all four dimensions. This may reflect the greater need for continuous adaptation and relationship-building during early adolescence. Repeated routines and teacher guidance may play a particularly important role in supporting student behavior and learning during this developmental stage.

The combined perspectives of teachers and students provide support for the view of the classroom as a dynamic and self-organizing system. Teachers perceive high levels of adaptive leadership and recognize great variability within classroom interactions, while students report relatively stable learning experiences and positive educational outcomes. This difference suggests that teachers need to continuously manage classroom complexity that students aren't fully aware of.

The findings support the theoretical role of habituation as a bridge between classroom variability and learning. Although teachers perceive considerable fluctuation in student behavior and attention, students report positively stable routines, increased participation, and a strong sense of safety during learning. This pattern is consistent with the perspective that adaptive leadership doesn't eliminate entropy, but it stabilizes it, so that classroom interaction promotes cooperation and interaction.

From a dynamic systems perspective, classroom order appears to emerge through continuous adaptation rather than through rigid control (De Felice et al., 2022). Teachers adjust communication, feedback, and pedagogical strategies in order to respond to

changing classroom conditions. At the same time, students gradually develop stable routines and learning behaviors. Therefore, the classroom can be understood as a living social system, where learning emerges from repeated interactions, adaptive regulation, and the gradual construction of patterns of behavior and meaning (Helterbran, 2016). Adaptive leadership contributes to the regulation of classroom dynamics, facilitating habituation and fostering learning outcomes.

### Conclusions

This article examined the relationships between adaptive leadership, classroom entropy, classroom habituation, and learning outcomes from the teachers' and students' perspectives. Classrooms function as dynamic and adaptive social systems rather than as static instructional environments (Mallows, 2002; Cameron & Larsen-Freeman, 2007). Learning appears to emerge through ongoing interactions, feedback processes, and collective adaptation, confirming that educational mechanisms are relational and systemic (Grisogono & Radenovic, 2011; Vetromille-Castro, 2013). The results indicate that adaptive leadership is present in both teacher and student perceptions, and that it appears to operate through flexibility, responsiveness, and emotional awareness. Rather than functioning as a mechanism of control, adaptive leadership seems to facilitate the regulation of the classroom dynamics, helping teachers to respond to complexity and uncertainty (Heifetz et al., 1997; Grisogono & Radenovic, 2011; Dunn, 2020).

Variability is a normal characteristic of classroom life, expressed through fluctuations, interruptions, and organizational challenges that characterize everyday classroom interactions. From a complexity perspective, entropy should not be seen just as disorder but as an inherent feature of open systems that continuously interact with their environment. As suggested by previous studies (Doyle, 1986; Csíkszentmihályi, 1990; Ahmad et al., 2021), learning environments require a balance between stability and change, since excessive disorder may reduce attention, participation, and engagement. Classroom order rests mainly on activities (Doyle, 1986) and repeated interactions, routines, expectations, and feedback gradually stabilize into patterns that foster learning. Classroom habituation may be understood as a collective adaptation process through which variability is transformed into order. The concept extends the original understanding of habituation as a reduction to repeated stimuli (Hawkins & Kandel, 1984; Rankin et al., 2009; Typlt, 2013;) and applies it to the social and relational dynamics of classroom life.

Adaptive leadership may be viewed as the invisible thread that connects entropy, habituation, and learning within an open system where individual minds fuse into a single system (Lieberman, 2013), so that diversity and complexity may be directed toward productive forms of organization. Classroom climate is a complex multidimensional construct (Wang et al., 2020) and it creates local order through ongoing adaptation in order to facilitate learning. Future research could further investigate how adaptive classroom processes evolve over time, studying the emergence of learning in unpredictable educational environments that mirror social ecosystems constantly challenged to adapt, reorganize and reinvent themselves.

### References

#### Articles

- Ahmad, M.I., Khan, I., Ahmad, M., Husain, A., & Jamaludin, R. (2021). Entropy in education system: Transformation of an individual through meaningful interactions in a community of inquiry. *Systemic Practice and Action Research*, 35, 591-606. <https://doi.org/10.1007/s11213-021-09585-6>
- Biesta, G. (2010). Why 'What Works' still won't work: From evidence-based education to value-based education. *Studies in Philosophy and Education*, 29, 491-503. <https://doi.org/10.1007/s11217-010-9191-x>

- Bratianu, C., & Bejinaru, R. (2019). The theory of knowledge fields: A thermodynamics approach. *Systems*, 7(2), 20. <https://doi.org/10.3390/systems7020020>
- Bratianu, C., & Lefter, V. (2001). *Management strategic universitar*. Editura RAO, Bucharest.
- Cameron, L., & Larsen-Freeman, D. (2007). Complex systems and applied linguistics. *International Journal of Applied Linguistics*, 17(2), 226-240. <https://doi.org/10.1111/j.1473-4192.2007.00148.x>
- Csikszentmihályi, M. (2014). Applications of flow in human development and education. In *The Collected Works of Mihaly Csikszentmihalyi*, Springer. <https://doi.org/10.1007/978-94-017-9094-9>.
- Chan, J.W. (2019). Role of teacher leadership in school development. *Research Journal of Education and Review*, 7(6), 074-076. <https://doi.org/10.5281/zenodo.3255017>
- Daniels, E. (2010). Creating motivating learning environments: What we can learn from research and students. *The English Journal*, 100(1), 25-29. <https://doi.org/10.2307/20787687>
- De Felice, S., de C. Hamilton, A.F., Ponari, M., & Vigliocco G. (2022). Learning from others is good, with others is better: the role of social interaction in human acquisition of new knowledge. *Philosophical Transactions of the Royal Society B*, 378, 1-12. <http://doi.org/10.1098/rstb.2021.0357>
- Djigic, G., & Stojiljković, S. (2011). Classroom management styles, classroom climate and school achievement. *Procedia - Social and Behavioral Sciences*, 29, 819-828. <https://doi.org/10.1016/j.sbspro.2011.11.310>
- Hallinger, P. (2003). Leading educational change: Reflections on the practice of instructional and transformational leadership. *Cambridge Journal of Education*, 33(3), 329-352. <http://doi.org/10.1080/0305764032000122005>
- Hawkins, R.D., & Kandel, E.R. (1984). Is there a cell-biological alphabet for simple forms of learning? *Psychological Review*, 91(3), 375-391. <https://doi.org/10.1037/0033-295X.91.3.375>
- Immordino-Yang, M.A., & Damasio, A. (2007). We feel, therefore we learn: The relevance of affective and social neuroscience to education. *Mind Brain and Education*, 1(1), 3-10. <https://doi.org/10.1111/j.1751-228X.2007.00004.x>
- Issah, M. (2018). Change leadership: The role of emotional intelligence. *SAGE Open*, 8(3), 1-6. <https://doi.org/10.1177/2158244018800910>
- Kandel, E.R., & Hawkins, R.D. (1992). The biological basis of learning and individuality. *Scientific American*, 267(3), 78-86. <https://doi.org/10.1038/scientificamerican0992-78>
- Knight, B. (2021). Classroom as complex adaptive system and the emergence of learning. In book: Pedagogy - Challenges, Recent Advances, *New Perspectives, and Applications* [Working Title], 1-23. <https://doi.org/10.5772/intechopen.101699>
- Kofman, F., & Senge, P.M. (1993). Communities of commitment: The heart of learning organizations. *Organizational Dynamics*, 22 (2), 5-23. [https://doi.org/10.1016/0090-2616\(93\)90050-B](https://doi.org/10.1016/0090-2616(93)90050-B)
- Larsen-Freeman, D. (1997). Chaos/Complexity Science and Second Language Acquisition. *Applied Linguistics*, 18(2). <https://doi.org/10.1093/applin/18.2.141>
- Mallows, D. (2002). Non-linearity and the observed lesson. *ELT Journal*, 56(1), 3-10. <https://doi.org/10.1093/elt/56.1.3>
- Wang, M.T., Degol, J.L., Amemiya, J., Parr, A., & Guo, J. (2020). Classroom climate and children's academic and psychological wellbeing: A systematic review and meta-analysis. *Developmental Review*, 57, 1-21. <https://doi.org/10.1016/j.dr.2020.10091>.
- Morin, E. (1992). From the concept of system to the paradigm of complexity. *Journal of Social and Evolutionary Systems*, 15(4), 371-385. [https://doi.org/10.1016/1061-7361\(92\)90024-8](https://doi.org/10.1016/1061-7361(92)90024-8)
- Mujari, M., Astuti, Y., & Surya, P. (2026). Adaptive leadership research trends in education. *Curricula: Journal of Curriculum Development*, 5(1), 133-148. <https://doi.org/10.17509/curricula.v5i1.93452>
- Rankin, C.H., Abrams, T., Barry, R.J., Bhatnagar, S., Clayton, D.F., Colombo, J., Coppola, G., Geyer, M.A., Glanzman, D.L., Marsland, S., McSweeney, FK, Wilson, D.A., Wu C.F., &

- Thompson, R.F. (2009). Habituation revisited: an updated and revised description of the behavioral characteristics of habituation. *Neurobiol Learn Mem*, 92(2), 135-138. <https://doi.org/10.1016/j.nlm.2008.09.012>
- Schmid, S., Wilson, D. A., & Rankin, C. H. (2015). Habituation mechanisms and their importance for cognitive function. *Frontiers in integrative neuroscience*, 8(97), 1-2. <https://doi.org/10.3389/fnint.2014.00097>
- Shi, P., & Liu, W. (2025). Adaptive learning oriented higher educational classroom teaching strategies. *Scientific Reports*, 15(1), 1-13. <https://doi.org/10.1038/s41598-025-00536-y>.
- Soares, L. (2020). Awakening teacher leaders: A new paradigm in education for school and student success. *PUPIL: International Journal of Teaching, Education and Learning*, 4(2), 96-106. <https://doi.org/10.20319/pijtel.2020.42.96106>
- Kennedy, N.S., & Kennedy, D. (2010). Between chaos and entropy: Community of inquiry from a systems perspective. *Complicity: An International Journal of Complexity and Education*, 7 (2), 1-15. <https://doi.org/10.29173/cmplct8917>
- Typlt, M., Mirkowski, M., Azzopardi, E., Ruth, P., Pilz, P.K., & Schmid, S. (2013). Habituation of reflexive and motivated behavior in mice with deficient BK channel function. *Front Integr Neurosci*, 7(79), 1-8. <https://doi.org/10.3389/fnint.2013.00079>
- Vetromille-Castro, R. (2013). Social Interactive Entropy and Interaction in the Language Teacher Education Classroom. *Revista Brasileira de Linguística Aplicada*, 13(2), 625-641. <https://doi.org/10.1590/S1984-63982013000200012>
- Yukl, G., & Mahsud, R. (2010). Why flexible and adaptive leadership is essential. *Consulting Psychology Journal: Practice and Research*, 62(2), 81-93. <https://doi.org/10.1037/a0019835>

### Online articles

- Bass, B.M., Avolio, B.J. (1993). Transformational Leadership and Organizational Culture. *Public Administration Quarterly*, 17(1), 112-121. <http://www.jstor.org/stable/40862298>
- Csikszentmihályi, M. (1990). *Flow: The Psychology of Optimal Experience*. HarperCollins. <https://files.blogs.baruch.cuny.edu/wp-content/blogs.dir/2418/files/2013/04/Mihaly-Csikszentmihalyi-Flow.pdf>
- Dagala, F.G., Kilag, O.K.T., Unuabia, R.P., & Arcillo, M.T. (2024). The Crucial Role of Educational Leaders in Optimizing School Efficiency. *International Multidisciplinary Journal of Research for Innovation, Sustainability, and Excellence*, 1(2), 368-374. <https://risejournals.org/index.php/imjrise/article/view/357>
- Doyle, W. (1986). Classroom Management Techniques and Student Discipline, 1-42. <https://eric.ed.gov/?id=ED315883>
- Dunn, R. (2020). Adaptive Leadership: Leading Through Complexity. In *International Studies in Educational Administration*, 48, (1), 31-38. [https://www.researchgate.net/publication/342902908\\_Adaptive\\_Leadership\\_Leading\\_Through\\_Complexity](https://www.researchgate.net/publication/342902908_Adaptive_Leadership_Leading_Through_Complexity)
- Glover, J.M., Friedman, H.L., & Jones, G. (2002). Adaptive Leadership: When Change Is Not Enough (Part One). *Organization Development Journal*, 20, 15. <https://www.indigenousspsych.org/Interest%20Group/Glover/2002AdaptiveLeaderODJ.pdf>
- Grint, K. (2005). Leadership: Limits and Possibilities. <https://www.semanticscholar.org/paper/Leadership%3A-Limits-and-Possibilities-Grint/41552b76a90a927ce6759c2e3a2f88c4ec9e3411>.
- Grisogono, A.M., & Radenovic, V. (2011). The Adaptive Stance - steps towards teaching more effective complex decision-making. [https://www.researchgate.net/publication/275342327\\_The\\_Adaptive\\_Stance\\_-\\_steps\\_towards\\_teaching\\_more\\_effective\\_complex\\_decision-making](https://www.researchgate.net/publication/275342327_The_Adaptive_Stance_-_steps_towards_teaching_more_effective_complex_decision-making)
- Goode, H., McGennissen, R., & Rutherford, E. (2021). An Adaptive Leadership Response to Unprecedented Change. In *International Studies in Educational Administration (Commonwealth Council for Educational Administration & Management (CCEAM))*, 49(1), 36. <https://bildungsmanagement.net/wp->

- [content/uploads/sites/4/2021/03/Huber-2021-SchoolingAndEducationInTimesOfTheCOVID-19Pandemic.pdf](https://content/uploads/sites/4/2021/03/Huber-2021-SchoolingAndEducationInTimesOfTheCOVID-19Pandemic.pdf)
- Heifetz, R. A., & Laurie, D. L. (1997). The work of leadership. *Harvard business review*, 75(1), 124–134. <https://pubmed.ncbi.nlm.nih.gov/10174450/>
- Heifetz, R., Grashow, A. & Linsky, M. (2009a). The Theory Behind the Practice: A Brief Introduction to the Adaptive Leadership Framework. <https://www.giarts.org/sites/default/files/workshop/ch-2-theory-behind-the-practice.pdf>
- Heifetz, R., Grashow, A. & Linsky, M. (2009b). Leadership in a (Permanent) Crisis. *Harvard business review*, 87, 1-9. [https://center-for-leadership.org/wp-content/uploads/2017/08/Leadership\\_in\\_Permanent\\_Crisis-copy-2.pdf](https://center-for-leadership.org/wp-content/uploads/2017/08/Leadership_in_Permanent_Crisis-copy-2.pdf)
- Helterbran, V.R. (2016). CHAPTER 12: Teacher Leadership: Overcoming “I am just a teacher” Syndrome. In *Counterpoints. Teacher Leadership: The “New” Foundation of Teacher Education: A Reader: Revised Edition*, 466, 114-120. <https://eric.ed.gov/?id=EJ930607>
- Kapoukranidou, D., Papachristou, P., & Gousopoulos, G. (2009). Molecular mechanisms of memory and learning. *Aristotle University Medical Journal*, 36(1). <https://ejournals.lib.auth.gr/aumj/article/view/4721/4822>
- Katzenmeyer, M., & Moller, G. (2011). CHAPTER ONE: Understanding Teacher Leadership. *Counterpoints, Teacher Leadership: The “New” Foundation of Teacher Education – A READER*, 408, 3-21. <https://www.jstor.org/stable/42981262>
- Martin, N.K., & Baldwin, B. (1993). Validation of an Inventory of Classroom Management Style: Differences between Novice and Experienced Teachers. <https://www.semanticscholar.org/paper/Validation-of-an-Inventory-of-Classroom-Management-Martin-Baldwin/b52841db3a63809348b6dcfbf0d9ed05d88d7365#citing-papers>
- Senge, P. M. (1999). It's the learning: The real lesson of the quality movement. *The Journal for Quality and Participation*, 22(6), 34-40. <https://search.proquest.com/docview/219178396/fulltextPDF/DD00929C63584C56PQ/1?aaccountid=10286>
- Senge, P.M. (1996) Leading Learning Organizations: The Bold, the Powerful, and the Invisible, published by Jossey Bass, Inc., a subsidiary of John Wiley & Sons Company, in *The Leader of the Future*, Goldsmith and F. Hesselbein, Eds. The Peter F. Drucker Foundation <https://solonline.org/wp-content/uploads/2016/12/Leading-Learning-Organizations-The-Bold-the-Powerful-and-the-Invisible-Senge.pdf>
- Senge, P., Lichtenstein, B., Käufer, K., & Bradbury, H. (2007). Collaborating For Systemic Change. *Sloan Management Review*, 48, 44-53. <https://stsrroundtable.com/wp-content/uploads/Senges-Collaborating-for-Systemic-Change-2007.pdf>
- Marshall, S.P. (1996). Chaos, complexity, and flocking behavior: metaphors for learning. [https://www.education.sa.gov.au/docs/curriculum/tfel/chaos\\_complexity\\_and\\_flocking\\_behaviour\\_metaphors\\_for\\_learning.pdf](https://www.education.sa.gov.au/docs/curriculum/tfel/chaos_complexity_and_flocking_behaviour_metaphors_for_learning.pdf)
- Squires, V. L. (2015). Tackling Complex Educational Challenges Through Adaptive Leadership. *Antistasis*, 5(1). <https://journals.lib.unb.ca/index.php/antistasis/article/view/22855/26615>
- Valerio, K.M.V. (2012). Intrinsic motivation in the classroom. *Journal of Student Engagement: Education matters*, 2(1), 30-35. <https://hdl.handle.net/10779/uow.27688173.v1>

## Books

- Csikszentmihályi, M. (1990). *Flow: The Psychology of Optimal Experience*. HarperConnins e-book.
- Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. The University of Chicago Press.
- Lieberman, M.D. (2013). *Social. Why our brains are wired to connect*. Oxford University Press.
- Owens, R. G. (2004). *Organizational behavior in education: leadership and school reform*. Boston, MA: Pearson Education.