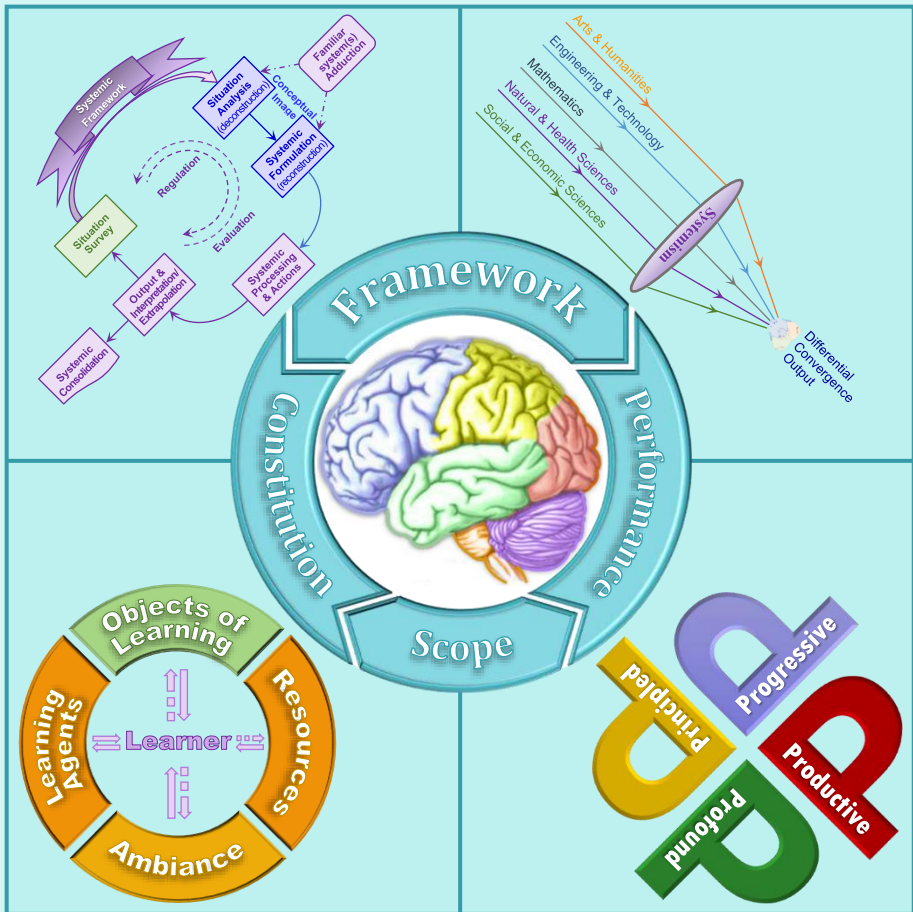


IBRAHIM HALLOUN

SYSTEMIC COGNITION AND EDUCATION



**Empowering Students
for Excellence in Life**

SYSTEMIC COGNITION AND EDUCATION

Empowering Students

for Excellence in Life

IBRAHIM HALLOUN



H Institute

Jounieh, Lebanon

In Press by

 Springer

Systemic Cognition and Education

Empowering Students for Excellence in Life

Systemic Cognition and Education (SCE) is envisioned to systematize the entire educational enterprise so as to empower students to think outside the box and excel in various aspects of life. SCE draws on philosophy, cognition, and latest developments in neuroscience, as well as on reliable educational theory and research. It offers substantiated mind-and-brain based experiential pedagogy, brings about coherence and consistency within and across disciplines and curricula, and lays the ground for efficient and just governance of educational systems and individual institutions.

SCE relies on *systemism* to provide a seamless paradigmatic perspective on education. According to systemism, we can best conceive and deal with the world within us and around us when we look at ourselves as biological and cognitive systems that constantly affect and are affected by local and global environments made of different sorts of systems. SCE calls then for education to transcend all traditional paradigms and settings, for systemism for excellence to prevail instead throughout educational systems, from pedagogy to governance, and from curricula to institutional organization, and for achieving and sustaining the systemic transcendence in partnership with various sectors of society.

The book is written for school teachers, university professors, graduate students, and all other educators, educationists, and stakeholders in various sectors of society. It is unique in presenting a coherent, across-the-board

CONTENTS			
Preface		ix	
<i>Chapter 1</i>			<i>Chapter 4</i>
Systemism: Coherence and consistency in thoughts and actions		1	Systemic Pedagogy: Experiential ecology for meaningful learning 133
<i>Chapter 2</i>			<i>Chapter 5</i>
Systemic Profiles: Habits and traits for excellence in life		39	Systemic Education: Curricula and governance for the 21 st century 199
<i>Chapter 3</i>			Glossary 245
Systemic Cognition: Mind-and-brain based lifelong learning		65	References 257 Index 267 About the Author 273

systemic perspective on various aspects of the educational enterprise, along with practical, cross-cutting guidelines for learning, instruction, curriculum design and implementation, and the overall educational ecology.

The book illustrates how SCE can be implemented according to these guidelines with a variety of examples accompanied with necessary tables, diagrams, and other practical tools. Some examples are discipline-specific, others cut across different disciplines and show how systemism ensures paradigmatic coherence and consistency within and across different disciplines and fields, especially fields like science and humanities traditionally treated in education as remote and totally distinct from each other. Practical tools include templates for outlining systems and systemic competencies in accordance with a unique and generic systemic schema, item maps for designing learning and assessment tasks, and assessment rubrics for ascertaining students' work in systemic and systematic ways.

Chapter 1

Systemism

Coherence and consistency in thoughts and actions

Systemism enables experts and students to undertake all their endeavors systematically, i.e., to work in consistent, orderly, and efficient ways, and to bring coherence within and across different disciplines and fields to the extent of bringing forth disciplinary convergence. Systematization is particularly important for meaningful construction and productive deployment of all sorts of knowledge. Convergence is crucial for success and innovation in the 21st century. It is about bringing and connecting together different disciplines from the same or different fields in order to tackle issues that neither discipline helps tackling well enough independently of other disciplines, and to bring about outcomes of unsurpassed value.

This chapter presents an overview of systemism as a worldview and a mindset. With a systemic worldview, we conceive everything within us and around us as consisting of interacting physical or conceptual systems or parts of systems (or of subsystems). Simply put, a system is an ordered unit or totality consisting of interconnected and interdependent physical or conceptual entities that come together or that are brought together in order to serve specific purposes under specific conditions. With a systemic mindset, we learn about, interact with, and modify both the physical world and the abstract realm of our own invention through appropriate conceptual systems that we construct to represent and investigate patterns of interest in either world or realm, and/or to make changes in these patterns or bring about new patterns altogether.

The chapter then introduces the systemic schema as a generic tool to define systems and system components, and illustrates with examples how this tool helps organizing knowledge in different fields. It also presents systemic ways to take advantage of such a tool for systematic knowledge construction and deployment. It finally discusses some advantages of systemism, going from infusing order in our thoughts and actions in any endeavor, to bringing pedagogical efficiency to formal education.

CONTENTS	
Introduction	1
1.1 Systemic worldview	5
1.1.1 Systems and systemic schema	6
1.1.2 Systems taxonomy	11
1.2 Systemic mindset	13
1.3 Systemic advantages	18
1.3.1 Order	19
1.3.2 Patterns	20
1.3.3 Stability and efficacy	22
1.3.4 Synergy	24
1.3.5 Ontological-epistemological consonance	25
1.3.6 Pedagogical efficiency	27

Chapter 2

Systemic Profiles

Habits and traits for excellence in life

Students who graduate with systemic profiles are empowered to excel in various aspects of life, from studying and working for self-fulfillment, to contributing to the welfare of others and the ecosystem. Systemic profiles that should make the prime object of formal education incorporate systemic habits of life and embody exceptional systemic traits.

Systemic habits of life are habits of looking at the world and dealing with it with systemic worldview and mindset. They evolve from gradual development of systemic competencies. A systemic competency consists of an appropriate mix of conceptions (concepts and relations among concepts), reasoning skills, sensorimotor skills, and axio-affective controls (in particular, a good value system and constructive attitudes and dispositions) that are necessary to successfully achieve a given category of tasks falling within the scope of a particular discipline or cutting across different disciplines from the same or different fields.

Traits promoted by SCE turn systemic profiles into what we call *4P profiles*. A person with a systemic 4P profile is characterized with a progressive mind that seeks to develop and constantly enhance productive habits for systematizing and optimizing the person quest for, and deployment of, profound knowledge that concentrates on substantial and generic conceptions and processes in any domain, all with commitment to principled conduct in all aspects of life.

The chapter begins with a broad taxonomy of declarative and procedural knowledge we ordinarily construct and deploy in our thoughts and actions. It follows with a discussion of systemic competencies as pedagogical vehicles for developing systemic habits of life at the core of systemic profiles that students need to develop. These profiles, like those of accomplished experts in different disciplines and fields, should ultimately turn into 4P profiles characterized with the four cross-cutting traits of progressive minds, productive habits, profound episteme, and principled conduct.

CONTENTS

Introduction	39
2.1 Knowledge dynamics	40
2.2 Systemic habits and competencies	43
2.3 Normative profiles	48
2.4 Systemic 4P profiles	50
2.4.1 Progressive mind	52
2.4.2 Productive habits	55
2.4.3 Profound episteme	58
2.4.4 Principled conduct	61

Chapter 3

Systemic Cognition

Mind-and-brain based lifelong learning

Learning is most meaningful and productive when it conforms in experiential ways to how our minds and brains are and how they efficiently work during cognition. Experiential learning takes place through transaction with real world situations and other people, teacher and peers included, and is most relevant when it relates to everyday life aspects of student interest and concern. Cognition is about memory development that takes place to adapt to new demands and that affects, even determines, how we think, perceive people and things, feel, act, and learn in the future.

The chapter concentrates on cognition aspects that are critical to experiential learning and that can and should be accounted for in formal education from two complementary perspectives, the subconscious neuro-anatomical and functional perspective of the brain, and the conscious cognitive perspective of the mind. Major pedagogical implications are drawn throughout this chapter and extrapolated in following chapters

Crucial brain anatomy and properties are quickly reviewed at first with a focus on engrams, the complex neuronal systems that constitute the physical

CONTENTS			
Introduction	65		
3.1 Transaction with the real world	67		
3.2 Brain plasticity, flexibility, and discrete functionality	71		
3.3 Memory	75		
3.3.1 Engrams	77		
3.3.2 Taxonomy	80		
3.4 Memory encoding	83		
3.4.1 Brain readiness	84		
3.4.2 Selective adaptive encoding	85		
3.4.3 Reiterative ontogenetic encoding	89		
3.4.4 Long active encoding	92		
3.4.5 Lifestyle dependent encoding	95		
3.5 Memory consolidation	96		
3.5.1 Distributed collective consolidation	97		
3.5.2 Rehearsal dependent consolidation	100		
		3.5.3 Pattern embedded consolidation	102
		3.5.4 Insightful challenging consolidation	104
		3.5.5 Differential dynamic consolidation	107
		3.6 Memory retrieval	109
		3.6.1 Differential memory processes	110
		3.6.2 Mutually dependent memory processes	112
		3.6.3 Mnemonics dependent retrieval	114
		3.7 Memory modulation	117
		3.7.1 Attention	118
		3.7.2 Motivation	120
		3.7.3 Emotions	122
		3.7.4 Control	125
		3.8 Metacognition	126

substrate of memory in the brain. The main three cognitive processes of memory encoding, consolidation, and retrieval are then discussed with particular attention to aspects bearing directly on the construction and deployment of knowledge of any sort in formal education. Similar attention is also paid in discussing modulatory systems in the brain that control the memory processes in question and that determine whether any learning experience goes on a constructive path or, instead, on a destructive or futile path. The chapter concludes with a recapitulation of discussed cognition aspects and their implications to metacognition and to how students should engage throughout life in any learning experience in order to come out with meaningful outcomes that significantly contribute to the development of systemic 4P profiles.

Chapter 4

Systemic Pedagogy

Experiential ecology for meaningful learning

Formal education is most efficient when all aspects of student and teacher education are coherently and systematically carried out under systemic pedagogical frameworks that foster the development of systemic 4P profiles in hands-on, minds-on experiential learning ecologies. These frameworks should keep away from traditional one-size-fits-all lecture and demonstration, account instead for student cognitive differences, and allow in well-structured structured but flexible settings for insightful regulation and development of student profiles under teacher mediation.

The chapter begins with an outline of meaningful learning by contrast to assimilation by rote of any object of learning. A discussion then follows with how systemic knowledge can be efficiently put together in middle-out modalities centered on systems and competencies from which one can go down the cognitive hierarchy to four types of learning outcomes distinguished according to a novel four-dimensional taxonomy, and up the hierarchy to the big paradigmatic picture within and across disciplines and fields. Knowledge at any level of the cognitive hierarchy, including conceptual systems and competencies, can be gradually developed through five stages of cognitive development, and is most meaningful when experientially developed in real-life situations which students are interested in. Knowledge development then takes place following systemic learning processes of defined procedural stages and in flexibly structured learning cycles whereby students can come to appreciate what they are proposed to learn, and to connect coherently what various parts of a given course and different courses are about. All along, students evaluate their knowledge and

CONTENTS	
Introduction	133
4.1 Pedagogy for meaningful learning	134
4.2 Systemic knowledge	138
4.2.1 Taxonomy of learning outcomes	139
4.2.2 Middle-out knowledge structure and development	146
4.2.3 Knowledge evolution	149
4.3 Experiential learning	155
4.3.1 Experiential ecology	156
4.3.2 Systemic learning	159
4.4 Learning cycles	163
4.5 Insightful dialectics	167
4.6 Learning mediation	173
4.7 Assessment and learning	179
4.7.1 Item maps	183
4.7.2 Assessment rubrics	186
4.7.3 Maps and rubrics for authentic assessment	189

regulate it insightfully, and develop it meaningfully under the mediation of teachers and other master learning agents. The chapter concludes with a discussion of how assessment can be carried out systematically with the use of proper tools like item maps and assessment rubrics, not as an end by itself but as insightful means for meaningful learning of systemic knowledge.

Chapter 5

Systemic Education

Curricula and governance for the 21st century

Formal education can most efficiently empower students to excel in life when it is systemic in practically every respect, from curriculum design and implementation, teacher training and working conditions, to governance of educational institutions and entire educational systems. In systemic formal education, teachers teach not to the test and not to inform students about specific disciplinary knowledge as passed along from one generation to another in traditional textbooks. Instead, teachers insightfully implement systemic curricula that they helped developing under mind-and-brain based pedagogical frameworks, and that they keep regulating to meet their students’ needs and prepare them to cope with the changing realities of the 21st century. Under propitious conditions, traditional disciplinary education would be ultimately transcended into systemic, praxis immersive, convergence education (SPICE) that brings up graduates who know how to think outside the box and excel in practical real-life situations in the most innovative ways possible.

This chapter addresses issues deemed critical to spread the seeds of systemic cognition and education in educational systems. It begins by discussing why and how we need to transcend traditional, one-size-fits-all disciplinary curricula, and adapt instead flexible, systemic curricula. Discussion then follows on how these alternative curricula can reasonably and feasibly become SPICE curricula by bringing together many disciplines under what we call differential convergence. A systemic curriculum would then be designed with proper scope and middle-out sequence around a limited number of powerful conceptual systems, and implemented in experiential learning ecologies that rely to the extent that is possible on praxis in order to bring theory and practice together in real-life settings with proper use of technology. The chapter concludes with a discussion of major aspects that help an educational system to be operated under a truly systemic governance for the benefit of students, teachers, and their communities.

CONTENTS

Introduction	199
5.1 Transcending traditional curricula	200
5.2 Systemic curricula	205
5.3 Differential convergence	207
5.4 Scope and sequence	216
5.5 Praxis	221
5.6 Technology	228
5.7 Educational systems	232
5.7.1 Paradigm shift	234
5.7.2 Middle-out systemic governance	236
5.7.3 Partnerships	238
5.7.4 Teaching profession	239
5.7.5 Exchange platforms	240
5.7.6 Student certification	241
5.7.7 Culture of excellence	242

ABOUT THE AUTHOR

Ibrahim Halloun is recognized worldwide for his seminal contributions to education. He is particularly known for his work on students' intuitive ideas about the physical world and their novice views about knowing and learning science, and for turning scientific models and modeling into pedagogical tools and methodology for experiential, meaningful learning of physics and other STEM disciplines at the secondary school and university levels.



Prof. Halloun has contributed to curriculum reform in many countries around the globe, and was behind several initiatives for systemic reform. He has been focused lately on systematizing the entire educational enterprise under systemic paradigms that meet the realities of the 21st century and that empower students to think outside the box and excel in various aspects of life. Systemic, praxis-immersive, convergence education (SPICE) is at the core of his attention, especially cross- and trans-disciplinarity that efficiently bridge traditional divides among disciplines from different fields like arts and science that are often misconceived as remotely related to each other.

Details at: www.halloun.net and www.hinstitute.org.