

Systemic convergence in education: A synopsis

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Numerous efforts have been deployed lately for *convergence* of research in different academic fields and operations in industry and various other sectors of society, i.e., for removing boundaries between distinct academic and professional fields in all domains, and carrying out processes, including knowledge development and problem solving, in coherent if not similar ways. Convergence is meant to facilitate and improve the efficiency of communication, knowledge exchange, and collaboration among various professionals on issues of mutual interest, especially in those fields that were traditionally considered as remotely related, if any, like arts and sciences. In education, convergence is primarily about bringing together many academic fields to come out with certain pedagogical products and processes that may extend from the solution to a particular type of abstract or real world problems to a full-fledge curriculum (Fig. 1).

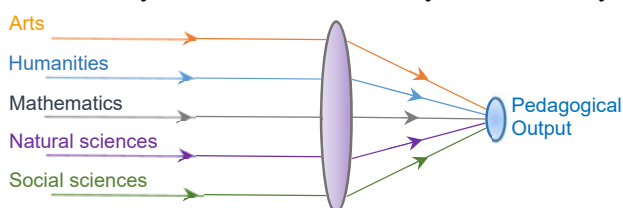


Figure 1. Convergence in education to bring about pedagogical products or processes of particular function.

Convergence among a number of fields for any purpose, educational purposes included, can be brought about through a variety of modalities with a diversity of conceptual lenses the most meaningful and efficient of which are *crossdisciplinary* and *transdisciplinary* modalities that rely on *systemic* lenses.

1. Convergence modalities

Convergence has sporadically and inconsistently taken place in education in the last few decades. It has followed a diversity of modalities, with no clear consensus on what a given modality may be about or called. To elicit differences as simply and concisely as possible among convergence endeavors that are most important to our work, we hereby distinguish, as we conveniently see it, the following convergence modalities in education and elsewhere (Table 1), be it for coming up with solutions to certain abstract or real world problems or the development and deployment of pedagogical approaches, tools, curricula, or any other product (or service).

Pluridisciplinarity results from the convergence without integration (synthesis) among disciplines, in fact disciplinary branches, in often the same academic field. A disciplinary branch is a particular area of a

A *framework* is a conceptual system that consists primarily of a set of tenets, principles, and rules for conceiving, developing, validating/corroborating, deploying, and continuously refining certain conceptual and/or physical products and/or services, and for choosing and deploying necessary means and methods to these five ends.

A *paradigm* is a complex conceptual system that governs all thoughts and actions of a given individual or, especially, a given community (group of people working towards common ends), and that consists primarily of a framework, a repertoire of conceptual and procedural knowledge including means and methods devised to bring about specific products/services for specific purposes.

Every professional community is characterized with a distinctive paradigm (or more) that is commonly accepted and systematically deployed (and continuously refined) by all members of the community. The community's repertoire of conceptual knowledge, especially when scientific, consists of corroborated theories, i.e., conceptual systems (conceptual models included) for which enough evidence has been gathered to establish their validity and reliability to deal with particular situations and bring about satisfactory solutions to abstract and/or real world problems.

Table 1
Classification and characteristics of major convergence modalities

Characteristics Modality	Same-Field disciplines	Different Fields	Outside needs	Disciplinary bridges	Framework grounds in disciplinary Paradigms	Content knowledge	Approaches	Product Characteristics (% existing)	Widening scope/horizons	New Discipline(s)
Pluridisciplinarity	Yes	No	No	No	Original	Original	Original	Similar	No	No
Multidisciplinarity	Yes	Yes	No	No	Original	Original	Original	Similar	No	No
Interdisciplinarity	Yes	Yes	Yes	Yes	Hybrid	Original	Original	Similar & few not	Yes	No
Crossdisciplinarity	Yes	Yes	Yes*	Yes	Emergent	Original & New	Original & Creative	Similar & not	Yes*	No
Transdisciplinarity	Yes	Yes*	Yes*	Yes	Transcendent	Original & New	Original & Innovative	Similar & not	Yes*	Yes

* Non-academic fields included.

given discipline characterized by its exclusive paradigm (e.g., the branches of classical mechanics and relativity in the discipline of physics). Professionals from different disciplines, and often the same field (e.g., natural sciences or any other field shown in Figure 1) work separately or cooperatively together in order to develop pluridisciplinary products and processes that fulfill their own immediate needs. They do so under separate frameworks, each of which draws exclusively on the paradigm of the respective discipline and in ways that preserve the integrity of the paradigm and discipline in question. Pluridisciplinary products have characteristics that are identical or similar to those of products already developed in the implicated disciplines.

Multidisciplinarity results from the convergence without integration of two or more disciplines (actually disciplinary branches), mostly from different academic fields. Professionals from various disciplines/fields work separately or cooperatively to develop multidisciplinary products entailed mostly by common interests and needs. They resort to this end to their distinctive conceptual and procedural knowledge within their distinctive settings (facilities, tools, resources, etc.) and under their distinctive paradigms in ways to preserve the integrity of their distinctive disciplines and everything they resort to. Multidisciplinary products have characteristics that are entirely reminiscent of products already developed in the original fields.

Interdisciplinarity results from the convergence of two or more disciplines (actually disciplinary branches), mostly from different academic fields. Professionals from various disciplines/fields work collaboratively together to develop interdisciplinary products needed within and/or outside their own professional communities, and deploy to this end joint efforts already established in their own disciplines. They bring together, to common facilities, their distinctive conceptual and procedural knowledge, tools, resources, etc., under a *hybrid* framework that draws on common and concurrent aspects of their distinctive paradigms. Interdisciplinarity preserves the integrity of the disciplines it originated from, but widens their implementation domain, i.e., it opens the door to new questions, problems, or issues to be tackled in ways already established in those disciplines. Interdisciplinary products have a mix of characteristics, some new and predominant others reminiscent of products already developed in the original fields.

Crossdisciplinarity results from the integrative convergence of two or more disciplines (actually disciplinary branches), mostly from different academic fields. Professionals from various disciplines/fields work collaboratively together to develop crossdisciplinary products needed within and/or outside their own professional communities, and deploy to this end a mix of already established and novel efforts. They bring together, to common facilities, their distinctive conceptual and procedural knowledge, tools, resources, etc., under an *emergent* framework that draws on common and concurrent aspects of their distinctive paradigms *and* incorporates newly agreed upon aspects. Unlike previous cases, the new framework includes novel (emergent) aspects that are compatible with the original paradigms but that cannot be attributed to any of those paradigms and the corresponding disciplines. The emergent framework opens the door to tackling in *creative* ways old and new questions, problems, or issues. Crossdisciplinary products have a mix of new and already known characteristics.

Transdisciplinarity results from the integrative convergence of two or more disciplines (actually disciplinary branches), mostly from different fields some of which may be non-academic fields related to any sectors of society. Professionals from various disciplines/fields (non-academic included) work collaboratively together to develop transdisciplinary products needed within and/or outside their own professional communities, and deploy to this end a mix of already established and novel efforts. They bring together, to common facilities, their distinctive conceptual and procedural knowledge, tools, resources, etc., under a framework that *transcends* all existing paradigms. In addition to drawing on common and concurrent aspects of their distinctive paradigms to come up with emergent aspects, professionals now go beyond their disciplines to come up with new paradigmatic premises possibly leading to the development of a brand new discipline that cuts across existing fields or that lays the ground for a completely new field. The transcendent framework opens the door to tackling in *innovative* ways old and new questions, problems, or issues. Transdisciplinary products may have a mix of novel and already known characteristics or entirely novel characteristics.

Our classification of convergence modalities is neither exhaustive nor exclusive at the level of both categories (modalities) and characteristics of each category. It is simply meant to reveal the extent to which convergence efforts may actually differ in foundation, process, and product, and to facilitate setting preferences in prospective convergence projects. One can easily realize that the conceptual and procedural complexity of distinguished modalities gradually increases from pluri- to trans-disciplinarity, and so do the extent of convergence and integration of implicated disciplines and the level of creativity and innovation in developed products (Table 1). We believe that in education one needs to ultimately shoot for cross-disciplinarity in secondary school and transdisciplinarity in college/university, for many reasons including the following:

1. The two modalities allow for all sorts of creative and innovative collaboration respectively among diverse fields in various public and private sectors of society. Such collaboration is nowadays badly needed in education to ensure sustainable educational systems and curricula that effectively meet the actual needs of individual growth and community development in the current century.
2. They provide for coming up with totally new educational systems and curricula that transgress the boundaries between traditional general and vocational establishments and disciplines. This is urgently needed in our times as traditional systems and curricula can no longer empower our students to meet the needs and overcome the challenges of the workplace and various aspects of our daily life.

3. They help educational systems and curricula become flexible and dynamic enough to provide for empowering students for lifelong learning and be continuously revised to meet the continuously changing requirements for induction and success in the workplace and every other aspect of modern life.
4. They lend themselves better than the other three modalities to creative and innovative converging lenses (Fig. 1) especially systemic lenses that allow us to accomplish all the above and more in the most meaningful, productive, and efficient ways possible (as implied by long years of educational research and practice, ours included).

2. Systemic Cognition and Education

Our thoughts and actions in various aspects of life, especially in formal education, are most effective when they are *systematically* carried out *systemically* in all situations, i.e., when we consistently and consciously approach any situation as being about a system or set of systems, or about a part of such system(s). A system may be defined in simple terms as a set of conceptual or physical elements that interact or are connected together within well-defined boundaries in order to serve specific purposes under particular conditions. The system as a whole has, and brings about products/services of, *emergent* properties and *synergetic* functions that cannot be attributed to, or brought about by, any of its constituents independently of other constituents, including when the system consists of professionals or groups of professionals coming from different disciplines.

The human brain is a dynamic system consisting of interconnected neural networks that work in concert together to allow us think, perceive the world around us, and act in this world so as to, ideally, responsibly ensure our personal welfare and the welfare of others and all organisms and entities we may affect in one way or another. The human body, the family, the school, the workplace, the society at large, the Earth, and the universe are all systems of particular make-up and function.

Systemic Cognition and Education (SCE) is a generic pedagogical framework for student and teacher education. SCE calls for all pedagogical products to be developed and deployed at all educational levels and in all educational sectors as dynamic systems in the framework of systemic curricula and the context of systemic learning ecologies. As such, various programs of study and pedagogical resources, textbooks included, would consist of systems defined in accordance with the same system schema (a template for system construction), and systematically constructed, deployed, and refined following systemic schemes. This helps readily converge different disciplines to bring about systemic, cross-disciplinary products. Details about SCE may be found at www.halloun.net/sce/.

3. Systemic convergence

Depending on the purposes we need to serve, we may resort to one convergence modality or the other. All modalities, but especially cross- and trans-disciplinarity, benefit the most when convergence is undertaken with systemic convergence lenses in the framework of SCE (Fig. 2).

Cross- and trans-disciplinarity surpass the other convergence modalities and may be put in practice in respectively

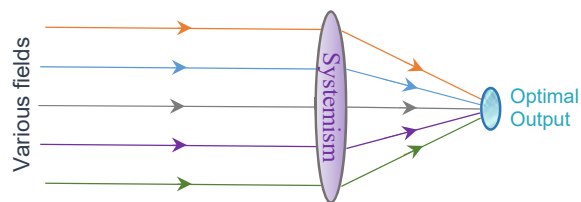


Figure 2. Systemic convergence to bring about optimal cross-disciplinary products and processes.

any secondary school and university course activity whatever the required end product and the desired convergence level may be. The two modalities are especially important for dealing with real world and daily life issues, and for doing so in a systemic perspective. When students are engaged collaboratively in systemic convergence projects related to their everyday life with these two modalities, numerous pedagogical purposes will be served in unique ways including but not limited to the following:

1. Systemic cross- and trans-disciplinary (X/TDP) projects provide secondary school and university students respectively (students, for short, hereafter) with the opportunity to learn best how to ask and answer proper questions about problematic real-life situations, and to practically relate to everyday life what they learn in various educational fields.
2. Systemic X/TDP projects help students develop a coherent paradigmatic picture of various conceptions (concepts and connections among concepts) within and across various fields, and to readily deploy in everyday life situations and subsequently connect and sustain in memory more meaningfully, productively, and efficiently – various conceptual systems, reasoning skills, dexterities (sensory-motor skills), and dispositions they traditionally develop in individual fields.
3. Systemic X/TDP projects help students take ownership and control of their learning ecology and experience, and develop, among other necessary positive emotions, the joy of self-esteem and self-satisfaction as a consequence of bringing about products that have the potential of contributing to their own welfare (useful knowledge included) and the welfare of their community.
4. Through collaborative learning, systemic X/TDP projects allow students to develop and ingrain effective social skills, including various forms of communication (artistic and esthetic, included), and rules and dispositions of efficient social interaction and teamwork.
5. Systemic X/TDP projects help students develop critical minds and the tendency and ability to constructively question all authorities and the viability of solutions proposed to community problems, especially when these projects deal with thorny issues of society and daily life.
6. All in all, systemic X/TDP projects significantly contribute to empowering students with overall systemic profiles of well-rounded citizens with progressive minds, productive habits, profound knowledge, and principled conduct in all aspects of life (i.e., 4P profiles called for in SCE, details of which are available at www.halloun.net/sce/).
7. Through systematic rubric-based monitoring and scrutiny of student performance on systemic X/TDP projects, teachers and students alike are especially capable of reliably ascertaining and regulating in practice skills, dexterities, and dispositions that cannot be reliably and effectively evaluated in traditional course activities and exams.
8. Systemic X/TDP projects engage schools (and universities) in close and productive cooperation with sectors of interest in the community, and thus, among others, help:
 - a) preparing students for eventual induction and success, even excellence, in productive sectors of society, and
 - b) engaging schools with such sectors in ways to benefit all parties and come up with products/services that neither party, especially schools, would have been able to bring about on its own.

9. Systemic X/TDP projects allow students and their schools and universities to open up to global trends in our constantly evolving world and accommodate themselves for constructive engagement in this world.
10. Systemic X/TDP projects allow students, teachers, and all other stakeholders to fully appreciate and pursue systemic convergence in various aspects of daily life, especially when these projects are systematically carried out in accordance with well-defined, and reliably established systemic schemes and schemata.