

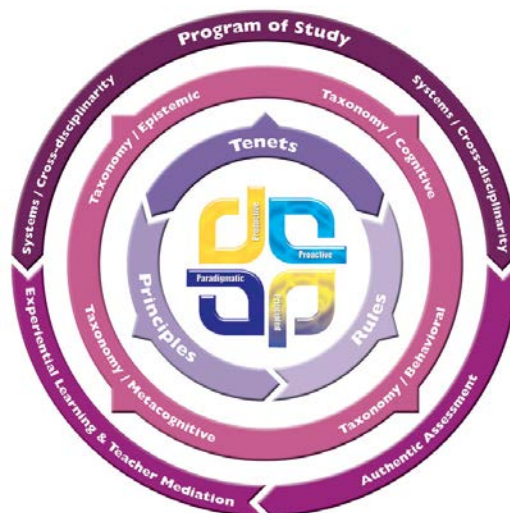
Taxonomy and Learning Outcomes in Profile Shaping Education

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Profile Shaping Education (PSE) is a generic pedagogical framework developed by this author, based on his work on Modeling Theory in Science Education*. PSE calls for education not to merely prepare students for passing exams, but to empower them with a profile for *success, and even excellence in modern life*.

The profile draws on research in cognition which shows that: (a) professionals, especially those in academic communities, share common expert paradigms** for knowledge construction and deployment, and (b) that there are patterns in the structure of expert paradigms and practice of accomplished professionals in various communities. PSE subsequently calls on education to systematically empower students with profiles that recapitulate such patterns, in particular the 4-P profile outlined below.

Under PSE, the profile is reified in various educational fields following well-defined cognitive tenets and pedagogical principles and rules. It can be translated in any given curriculum in the form of epistemic, cognitive, behavioral and metacognitive learning outcomes in accordance with a novel taxonomy developed by this author. This is a research-based, generic four-dimensional taxonomy that may be applied under any pedagogical framework to specify conceptions, reasoning skills, dexterities and dispositions that students need to achieve in any educational field for success in modern life.



Paradigmatic

A paradigmatic student realizes that knowledge construction and deployment in every profession are governed by certain paradigm(s) in line with which s/he needs to develop her/his own profile. For efficient transcendence of personal paradigm(s), the student concentrates on a balanced and comprehensive repertoire of foundational and generic episteme and cross-disciplinary habits of mind that allow her/him to realize the big picture within and across disciplines.

Productive

A productive student relies on systematic ways and means, cognitive and technical, for meaningful development and constructive deployment of conceptions and mental and behavioral habits within each discipline, and for productive and creative extrapolation of conceptions and habits into other disciplines and everyday life.

Proactive

A proactive student adopts a clear vision of her/his education and future, and develops an affinity for detecting and resolving problems, and for anticipating new challenges and coping with them. The student continuously seeks, and assumes control of, new learning experiences in order to evaluate and regulate her/his own profile. S/he constructively engages with others to help them do the same, and subsequently to empower self and others for lifelong learning and continuous profile development.

Principled

A principled student embraces positive dispositions, especially those that characterize her/his own culture and expert paradigms, and interacts conscientiously, respectfully and constructively with others and the physical environment.



* Halloun, I. (2011). Profile Shaping Education. A paradigm shift in education to empower students for success in modern life. *11th IHPST Conference Proceedings*, pp. 337-343. Thessaloniki, Greece: IHPST.

** An expert paradigm consists, for us, of: (a) major tenets (i.e., metaphysical, foundational axioms), principles and rules that govern development and deployment of (b) habits of mind (skillful mental processes and dispositions) and (c) episteme or a coherent epistemic repertoire (a body of conceptions or conceptual knowledge which, in science, makes up a corroborated scientific theory or set of such theories), all of which being accepted and shared by a community of professionals.

1. TAXONOMY

Taxonomy is the main interface between the framework of a curriculum and its practical aspects, namely the program of study of the corresponding field(s) at each grade level, and the means and methods of learning, instruction and assessment. The main goal of any curriculum, as we see it, is to help students develop a particular profile by the end of schooling years. While PSE works to empower students with the 4-P profile outlined above, other pedagogical frameworks define the target profile under different names, and in different ways. Ideally, the profile is practically translated into “expectations”, or reifiable outputs of one form or another which students are expected to achieve in certain respects and to certain extents by the end of each grade or educational level (e.g., outcomes, benchmarks, competencies, or objectives). Under PSE, the 4-P profile is preferably translated into “learning outcomes” which students are expected to gradually develop within and across grades.

Taxonomy, in general, is a generic tool that classifies expected outputs of any sort (learning outcomes or other) in a way that facilitates the deployment of a curriculum in all respects, from textbook authoring, to lesson planning and execution, to assessment. The classification is artificial, in the sense that profile constituents like conceptions and reasoning skills are not anatomically distinguished as such in our brain, and a variety of such constituents is always invoked simultaneously in our mind, in any mental or physical activity (although one constituent may dominate others). However, it is necessary to properly organize expectations in education and monitor how well they are individually achieved. That’s what taxonomy is for.

Our taxonomy is four-dimensional: epistemic, cognitive, behavioral and metacognitive. The *epistemic* dimension helps spelling out everything students need to “know” about various *conceptions* in any educational field. Conceptions include concepts, laws, principles, theorems, and any other statement accepted by a given community of professionals (the entire repertoire of which makes up the “episteme” of that community). The *cognitive* dimension helps identifying the *reasoning skills* required for meaningful understanding and productive deployment of these conceptions, individually or together in specific models or systems. The *behavioral* dimension helps specifying the *dexterities*, or practical skills (or competencies for some), required for the same purpose. The *metacognitive* dimension helps indicating the *dispositions* needed to control student engagement in the other three dimensions for efficient and meaningful profile development and deployment.

Each of the four dimensions consists in our taxonomy of five facets. The epistemic dimension covers the content knowledge pertaining to the scope and structure of any conception, and more specifically its domain and function (scope), along with its composition, internal structure and external structure (structure). The cognitive dimension includes analytical, criterial, relational, critical, and logical reasoning. The behavioral dimension includes communication, ICT, manipulative, artistic and eco-engagement dexterities. The metacognitive dimension consists of affects, attitudes, morals and ethics, values, and views and beliefs. The four taxonomy dimensions and their facets are outlined in Table 1.

In PSE, we prefer to define the scope of any field in terms of a limited number of physical and/or conceptual systems that best reflect the field paradigm(s) and match students’ cognitive level, and that empower students for lifelong learning and success in modern life. A *physical system* is a set of interacting material bodies that reflects a given *pattern* in the structure and/or behavior of the real world (e.g., an atom, the human cell or nervous system, the solar system, or a social system). A *conceptual system* is a set of interacting mental or abstract entities that reflects a given *pattern* in the epistemic realm of a given profession (e.g., a narrative text, a scientific model or theory, an economic model or theory, or the constitution of a country).

Table 1
The PSE Taxonomy

Dimension	Facet	Description	Typical Expectations
Epistemic <i>Content (conceptual) knowledge about the scope and structure of a given system</i>	Scope/ Domain	What pattern the system manifests or represents, where the system applies, and under what conditions.	Knowledge of the pattern and its referents, knowing in what respects a system represents the pattern, when it does and when it stops doing so.
	Scope/ Function	What the system is good for, or what it can be used for, and to what extent.	Knowledge of what the system helps us understand about the pattern, and how to benefit of it, in the context of a given theory or paradigm.
	Structure/ Composition	What primary entities (object and property concepts) the system consists of, and how they can be depicted.	Knowledge of the primary concepts of the system and of what makes them salient intrinsically and externally.
	Internal Structure	Relationships among the entities inside the system, and among the properties of such entities.	Knowledge of how the primary concepts of the system relate to each other to manifest the pattern of concern.
	External Structure	Relation of the system as a whole with its environment, or with other systems, within or outside the field of study.	Knowledge of how the system relates to other systems manifesting the same and related patterns, and how it fits in the corresponding theory and paradigm.
Cognitive <i>Reasoning skills for the construction and deployment of the system</i>	Analytical reasoning	Analysis of the state (or change of state) of the system, and distinction between primary and secondary aspects describing and affecting that state, in the context of the corresponding theory and paradigm.	Exploration (comprehensive survey), differentiation (distinction between primary and secondary aspects), description, explanation, prediction, controlled change, SWOT analysis.
	Criteria reasoning	Criteria-based processes about various aspects of the system in reference to the pattern it represents and the theory and paradigm it belongs to.	Comparison, contrast, classification, pattern recognition, analogical reasoning, estimation, measurement, setting criteria for objective reasoning.
	Relational reasoning	Establishing viable relationships among various aspects of the scope and structure of the system, and between this system and other systems in its theory and paradigm, in the form of laws, principles and other conceptions.	Knowledge organization, syntactical (internal) connections, bridging / external connections, correlation, functional relation, synthesis, extrapolation, transfer, setting model structure.
	Critical reasoning	Inquiry and insightful reflection about the scope and structure of the system and its merits, and about pertinent statements, in the context of the corresponding theory and paradigm.	Purposeful and critical information gathering, reflective thinking, evaluation of evidence and claims, corroboration of claims and hypotheses, questioning “facts”, question formulation, problem detection & formulation, challenge anticipation.
	Logical reasoning	Inferences and evidence-based argumentation about various aspects of the system, and design and implementation of various strategies and processes of problem solving, in the context of the corresponding theory and paradigm.	Evidence-based arguments, corroboration, justification, proof, hypothesis formulation, assumptions making, conjecturing, decision making, solution design and deployment, adduction, induction, deduction, generalization, metaphorical reasoning, esthetic reasoning.

The PSE Taxonomy (continued)

Dimension	Facet	Description	Typical Expectations
Behavioral <i>Dexterities for the construction and deployment of the system</i>	Communication dexterities	Systematic expression and negotiation of various facets of the system, with appropriate forms of expression and depiction, and in accordance with sound semantic rules.	Purposeful and critical listening; verbal, symbolic, graphic, kinesthetic expression; semantic interpretation, coordination of various depictions, sense making, multi-purpose and multi-audience communication, note taking, eloquence.
	ICT dexterities	Efficient and constructive use of computers, peripherals, and all sorts of ICT media (hardware and software) that help in the construction and deployment of the system.	Operation of ICT equipment and software according to appropriate rules, network search, web interaction, carrying out ICT-based projects, e-learning, e-assessment.
	Manipulative dexterities	Efficient and constructive use of all sorts of tools and technical devices, typical of those used in school laboratories and shops, needed for system construction and deployment.	Development of physical dexterities and sense-coordination, safe and productive operation of hardware, reparation and construction of specific system components or system-related entities that are pertinent to everyday life.
	Artistic dexterities	Creative use of graphic arts and design, and other artistic tools, in the conception, design and reification of necessary means for efficient and esthetic system construction and deployment.	Refinement of all senses, affinity to aesthetics in the design and construction of physical and abstract entities, manual and computer-based production of blue-prints and other technical drawings, graphic arts production.
	Eco-engagement dexterities	Efficient and constructive interaction with others and the environment, inside and outside the classroom, and eco-conscious system construction and deployment.	Self-management, eco-conscious interaction with others (especially peers during teamwork) and the environment, crisis management, ecologic entertainment.
Metacognitive <i>Dispositions that govern system construction and deployment</i>	Affects	Intrinsic positive feelings about the personal relevance of the system, and self-determination for continuous drive for better and more beneficial system construction and deployment.	Intrinsic locus of control, confidence, self-awareness, impulsivity control, perseverance, commitment, affinity for auto-regulation, curiosity, imagination, creativity, striving for excellence, efficiency.
	Attitudes	Extrinsic positive feelings toward the field of study and others, especially peers and teacher, and determination for constructive, synergetic and respectful interaction with the learning environment.	Open-mindedness, inter-dependence, tolerance, empathy, flexibility, objectivity, skepticism, constructiveness, humor, synergy dedication, calculated risk taking.
	Morals & Ethics	Ethical conduct in the classroom and beyond, by conformity to globally valued morals and codes of conduct adopted by professionals in the field of study.	Honesty, honor, integrity, fairness, ethics of the discipline, regulation abiding, equity, justice, precision, upholding accuracy, no tolerance for cheating and plagiarism.
	Values	Respect of one's own and others' culture and heritage, and of one's own and others' rights and duties, and the drive for personal and collective excellence in education and life.	Respect of others' rights; respect and fostering of one's own heritage and culture; respect and appreciation of diversity, freedom, arts, order, cleanliness.
	Views & Beliefs	Belief in personal and collective ability to reach excellence, and adherence only to sustainable and corroborated positions regarding the field of study and all aspects of life.	No unsustainable beliefs, differentiation between belief and knowledge, evidence-based conviction, belief in one's own ability to make a difference.

Epistemic, cognitive, behavioral and metacognitive learning outcomes are thus spelled out for meaningful construction and deployment of systems that best reflect critical *patterns* in a given field and across fields. Moreover, and as reflected in Table 1, PSE focuses primarily on *cross-disciplinary* outcomes, i.e., outcomes that are at the crossroads of various fields, and that are most critical for realizing the big paradigmatic picture within and across fields.

2. LEARNING OUTCOMES

A *learning outcome* is what a student is expected to reify or achieve in meaningful and measurable ways, at a given stage, about a particular conception (*epistemic* learning outcome), reasoning skill (*cognitive* learning outcome), dexterity (*behavioral* learning outcome) or disposition (*metacognitive* learning outcome). The extent to which an outcome is actually reified (achieved) is determined in PSE, in terms of specific quantitative *indicators* associated with particular *scales*. Scales and indicators are specified in appropriate rubrics, so as to reflect the stage to which the student profile has evolved, and provide guidance for necessary feedback to the student.

A PSE learning outcome satisfies a number of conditions, including but not limited to the following:

Transparent: The outcome must be stated in a way to readily reflect what dimension of the taxonomy it is about (epistemic, cognitive, behavioral or metacognitive), what facet it is about in a given dimension, and to what extent a student is expected to develop a particular conception, reasoning skill, dexterity or disposition.

Self-contained: The outcome must contain all the information needed for a teacher to know what exactly a student is expected to have developed/achieved about a given facet, and what to ascertain in the student profile in order to determine the extent to which the outcome has been achieved.

Clear (objective and precise): All concerned teachers must be able to interpret the outcome exactly the same way, and agree on what they need to do in the classroom in order to help students develop the outcome and reliably assess student achievement of the outcome.

Measurable: The outcome must be measurable as stated, and include what exactly need to be ascertained in order to assess student achievement of the outcome.

Relevance to the 4-P profile: The outcome must be clearly related to a specific trait of the 4-P profile, and should readily set the level at which that trait has been achieved.

Viable: The outcome can actually be achieved by the concerned students given their intellectual stage, and outcome development can be mediated by the teacher within the confinement of existing curricula and instructional settings, or with affordable changes therein.

Transportable: The outcome is viable and can be achieved, even if in certain respects and to a certain extent, under any pedagogical framework other than PSE.

3. GRADUAL DEVELOPMENT OF LEARNING OUTCOMES

There is no particular cognitive hierarchy among the four dimensions of the taxonomy or among the five facets in any dimension. However, a certain hierarchy may be identified

within each facet that depends on the complexity of, and cognitive demands imposed by, each facet or expectation within.

For example, within the cognitive facet of analytical reasoning, we may distinguish between exploration and differentiation, or between description, explanation and prediction. Exploration is about the comprehensive survey of particular situation (system or phenomenon), without distinction between various elements in that situation. Differentiation, however, is about distinguishing between primary and secondary factors, i.e., and respectively, between factors that are pertinent to the situation and those that are not. Description and explanation are respectively about how and why the situation exists as it does at a given point of space and time, while prediction is about how the situation may evolve in the future under certain conditions, or about how it used to be in the past (post-diction) before it got to the current state. One can readily realize that differentiation comes at a higher cognitive level than exploration, and that prediction comes at a higher level than explanation (identifying primary causes of a given situation) followed by description (identifying primary constituents of the situation).

According to PSE, the profile of a person evolves in four consecutive stages across various grade levels. Those stages are best understood in the context of particular systems in a given educational field, as detailed along the four dimensions of the taxonomy. Accordingly, any person may progressively develop all sorts of outcomes about a given system in the following four stages:

1. *Initiation (primitive learning)*, when a learner is simply aware that the system exists, but knows nothing or a little about its scope and structure, and is still incapable of successfully developing or deploying necessary conceptions, reasoning skills, dexterities and dispositions in any situation.
2. *Gestation (rote learning)*, when the learner develops partial knowledge about the scope and structure of the system, and is capable of deploying certain conceptions, reasoning skills, dexterities and dispositions, exclusively in the context of the system in question when encountered in familiar situations.
3. *Replication (reproductive learning)*, when the learner develops satisfactory knowledge about the scope and structure of the system, and is capable of deploying conceptions, reasoning skills, dexterities and dispositions, exclusively in the context of the system in question, when encountered in familiar situations and new, but mostly similar, situations.
4. *Innovation (productive learning)*, when the learner develops comprehensive knowledge about the system, and is capable of creatively deploying corresponding conceptions, reasoning skills, dexterities and dispositions, within the context of the same and other systems encountered in totally novel and unfamiliar situations.

Table 2
PSE Developmental Stages

Stage	Profile	Conception	Reasoning	Dexterity	Disposition
1	Initiation	Encounter	Inception	Observation	Awareness
2	Gestation	Recognition	Attempt	Approximation	Adaptation
3	Replication	Comprehension	Reproduction	Performance	Compliance
4	Innovation	Understanding	Production	Perfection	Commitment

Table 2 shows the terms used in PSE to indicate the level at which students are expected to develop each facet at a given stage of profile development. As indicated above, a student may be at different stages in the four dimensions of the taxonomy, or even relative to the five facets within the same dimension. However, a given profile stage necessitates that the student reaches exactly the same stage in all four dimensions of the taxonomy.

4. PROFILING RUBRIC

Assessment in PSE is not an end by itself. It is meant to be authentic assessment “*for*” meaningful learning and not assessment “*of*” rote learning of course materials. PSE assessments are thus designed to guide learning and instruction. To this end, assessment items of any type or form are written, and student performance marked, so as to indicate to what extent the student has developed a given conception, reasoning skill, dexterity or disposition. The following rubric reflects the 4-stage profile evolution discussed above to guide the process of accumulating “scores” on various items pertaining to a given dimension in the taxonomy of Table 1, and to indicate the level at which the profile of a given student has evolved along that dimension.

Table 3
Profiling Rubric

Level	Epistemic	Cognitive / Behavioral / Metacognitive
1	The student has <i>barely</i> realized, if any, the scope or structure of a system.	The student <i>barely</i> demonstrates her/his ability to deploy the habit (reasoning skill, dexterity or disposition) in the context of any system.
2	The student has <i>partially</i> realized the scope and structure of a system as demonstrated in <i>familiar</i> situations.	The student demonstrates her/his ability to <i>partially</i> deploy the habit in the context of certain <i>familiar</i> systems/ situations.
3	The student has realized the scope and structure of a system, <i>to the extent that is required</i> , as demonstrated in <i>familiar</i> situations or similar new situations.	The student demonstrates her/his ability to deploy the habit, <i>to the extent that is required</i> , in the context of <i>familiar</i> systems/situations or similar ones.
4	The student has reinforced her/his knowledge about the scope and structure of a system <i>beyond what is required</i> , as demonstrated in new situations that are <i>not similar</i> to familiar ones.	The student demonstrates her/his ability to deploy the habit <i>beyond what is required</i> , in the context of new systems/situations that are <i>not similar</i> to familiar ones.