How People Learn: Cognition, Affect, and Learning
—The Role of Emotions in Learning

Barry Kort Ph.D. and Robert Reilly Ed.D.
{kort, reilly}@media.mit.edu
formerly MIT Media Lab

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Learning is the quintessential emotional experience.

Our species, *Homo Sapiens*, are the beings who think. We are also the beings who learn, and the beings who simultaneously experience a rich spectrum of affective emotional states, including a selected suite of emotional states specifically and directly related to learning.

This proposal reviews previously published research and theoretical models relating emotions to learning and cognition and presents ideas and proposals for extending that research and reducing it to practice.

Our perspective

The concept of affect in learning (*i.e.*, emotions in learning) is the same pedagogy applied by an athletic coach at a sporting event. A coach recognizes the affective state of an athlete, and, for example, exhorts that athlete toward increased performance (*e.g.*, raises the level of enthusiasm), or, redirects a frustrated athlete to a productive affective state (*e.g.*, instills confidence, or pride). A coach recognizes that an athlete's affective state is a critical factor during performance; and, when appropriate, a coach will intervene with a meaningful strategy or tactic. Athletic coaches are skilled at recognizing affective states and intervening appropriately.

Educators can have the same impact on a learner by understanding a learner's affective state and intervening with appropriate strategies or tactics that will meaningfully manage and guide a person's learning journey.

There are several learning theories and a great deal of neuroscience/affective research. However, that research has not yet contributed to a balanced comprehensive pedagogical model that reduces those findings to practice.

Thus, there is an absence of a **balanced comprehensive pedagogical model** from which **educators can accurately observe/recognize affect and apply an intervention strategy or tactics,** on-the-spot, that will meaningfully aid a person during their learning journey.

We propose to continue building our **comprehensive pedagogical model**, which was funded by two NSF grants**.** This model facilitates the delivery of knowledge from a model-based domain[1] (*e.g.*, any STEM domain). We seek to further evolve this model into a more comprehensive model that explains the various components, strategies and tactics that must be woven together to craft a meaningful learning journey (*e.g.*, emotions that drive and inhibit learning, mechanics of a model-based knowledge domain vs. a rule-based knowledge domain[2]. We propose to further investigate, for example: the 5-stage sequence between rules and models (*i.e.*, rules, protocols, functions, models, systems)), the impact of mood, the nature of a learning curve, brain-based functions, cognitive dissonance, zone of flow, mechanics of the *teachable moment*, inferring affective state and invoking an appropriate strategies or tactics, Socratic dialog, pathological learning).

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[1] Model-based domains contain knowledge that is built upon scientific theories/laws and the knowledge (*e.g.*, physics, engineering).
[2] Rule-based domains contain knowledge the is typically arbitrary and is applied universally (*e.g.*, language, spelling).

Creating a balanced comprehensive pedagogical model

> *[In the 1970s], educators paid little attention to the work of cognitive scientists, and researchers in the nascent field of cognitive science worked far removed from classrooms. [In the early part of the 21st Century], cognitive researchers [began] spending more time working with teachers, testing, and refining their theories in real classrooms*
>
> – John Bransford (ed.), *How People Learn: Bridging Research and Practice*

While cognitive researchers have been "refining their theories in real classrooms" (Bransford, 2000), the impact of affect on learning has been "ignored or marginalized" (Picard, 2004). *Gamification* (*i.e*., games and entertainment applications) and *monetization* of technology have created excellent products (*i.e*., medical applications (*e.g*. health, exercise, patient monitoring & alerts), commercial applications (*e.g*. adaptive personalized advertising), educational applications (*e.g*., tutoring/mentoring systems). Nonetheless, this has caused a departure away from evolving a comprehensive model of **how people learn**. Current teaching-learning methods continue to focus on a model that provides 'information' (or 'data') to learners (Figure 1) rather than providing knowledge and wisdom. High-stakes testing, which assesses a person's ability to only draw out 'information', drives this; and those who can extract 'information' are judged to be 'educated' or 'intelligent'—but this is not knowledge acquisition, which is a person's ability to organize and appropriately apply information/data. This approach/belief does little to provide learners with needed problem-solving skills. It only develops rule-based learners in an era that must have model-based reasoners also known as systems thinkers.

To understand the need for a novel model, let us first examine the current educational model, which is shown in Figure 1. This begins with 'data,' which is a collection of answers to questions that the learner has not yet seen fit to ask or needs to ask. Such data becomes 'information' when it answers a question that the learner cares to ask or the educator provides. For the most part, an educator must somehow motivate the learner to care enough to seek the answers found in the data, in a Socratic approach the 'teacher' supplies curiosity-developing questions to encourage the learner to 'study' and learn. Studying is like 'panning for gold' where the answers are the 'nuggets' buried in a ton of otherwise uninteresting gravel. Once we have our 'nuggets of information' how do we organize them into a 'body of knowledge'? We may think of 'information' as the pieces of an unassembled jigsaw puzzle, whereas 'knowledge' is the assembled jigsaw puzzle. That is, the question-answer (Q&A) pairs are organized into a coherent structure, in the logical and natural order in which new questions arise as soon as old ones are answered.

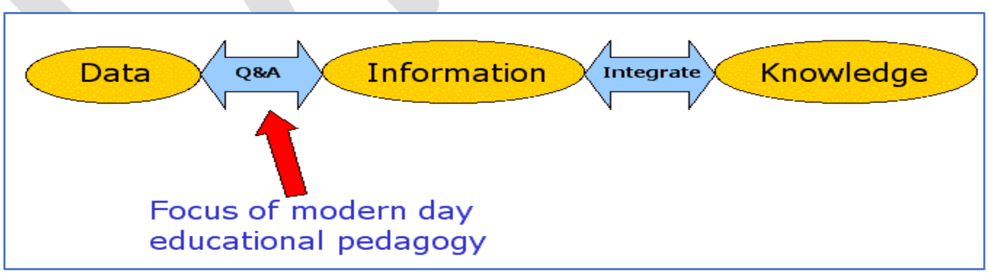

Figure 1 – Illustration for delivery of knowledge from a rule-based domain.
Elements of learning in conventional classroom pedagogy.

The assembled 'jigsaw puzzle of knowledge' reveals a previously hidden picture—a 'big picture,' if you will. Or to put it another way, the assembled 'jigsaw puzzle of knowledge' is a tapestry into which is woven many otherwise hidden and previously unrevealed stories. The illustration in Figure 1 accommodates rule–based knowledge where only 'rules' are involved. The 'rules' are applied in every situation (*e.g*., apple is always spelled the same way). This model does not accommodate model-based knowledge where the theories must be understood to the extent that they must be applied appropriately in ever-varying situations.

Our novel model (Figure 2 below) goes beyond the model in Figure 1. The focus of attention shifts to the **construction of 'knowledge' and to the extraction of meaningful 'insights'** from the 'big picture.' When 'knowledge' is coupled with a personal or cultural value system, 'wisdom' emerges. In other words, wisdom allows us to harness the power of knowledge for beneficial purposes.

'Wisdom' affords us the possibility of extracting the stories woven into the tapestry of knowledge. So, from 'wisdom' we craft the bardic arts of story making and storytelling. The ancients created myths and legends. These were the prototypical stories of their cultures, which were intended to impart 'wisdom.' A story is thus an anecdote drawn from the culture. A well-crafted anecdote or story has value both as an amusement and as a source of insight into the world from which it is drawn. And the plural of 'anecdote' is data—a collection of anecdotal stories or evidence. This observation closes the loop in Figure 2.

Figure 2 suggests a novel model that, on a fundamental level, supports an improved educational pedagogy. This will serve as a foundation for the next part of our model—**how a learner's affective state should be incorporated into this overall model** and what other components provide significant support.

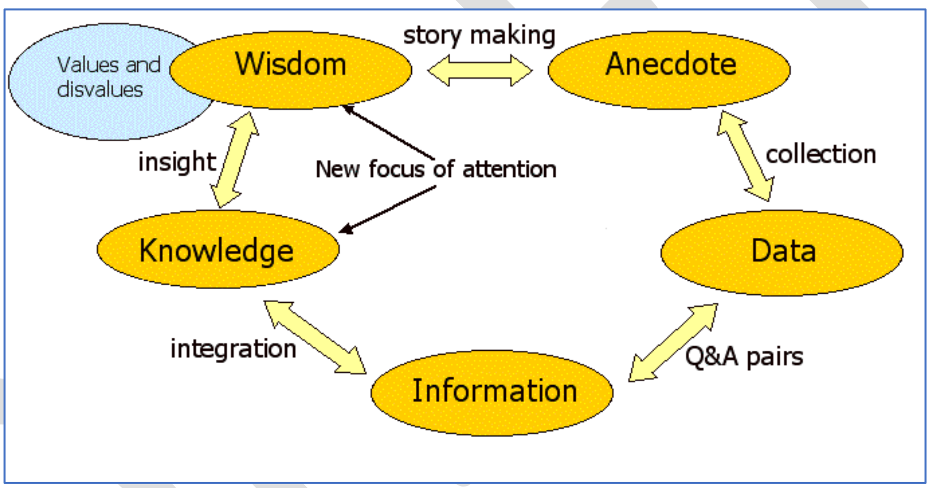

Figure 2 – Model for delivery of knowledge from a model-based domain

While proceeding through a model-based knowledge domain as illustrated in Figure 2, the learner's journey can be managed by understanding the effects/impact of various emotions (*e.g*., curiosity, frustration, ennui, anxiety). This knowledge is particularly valuable if an educator understands what emotional states can be employed during a person's learning journey and understands how various emotional states can provide a meaningful impact to move a learner forward.

Our first step is to offer a model of a learning cycle, which integrates affect. Figure 4 suggests six possible emotion axes that may arise while learning. Figure 3 denotes the herky-jerky nature of a typical learning journey (a non-monotonic process).

Figure 3 reflects the ups and down of the rollicking learning curve. This is 'non-monotonic learning'. It portrays that a learner acquires erroneous beliefs and misconceptions, which are eventually discarded. Superimposed in Figure 4 is 'Frowny Face Scowl' and a 'Happy Face Smile' to illustrate the emotional states are variously negative valenced (unhappy) or positive valenced (happy learning curve).

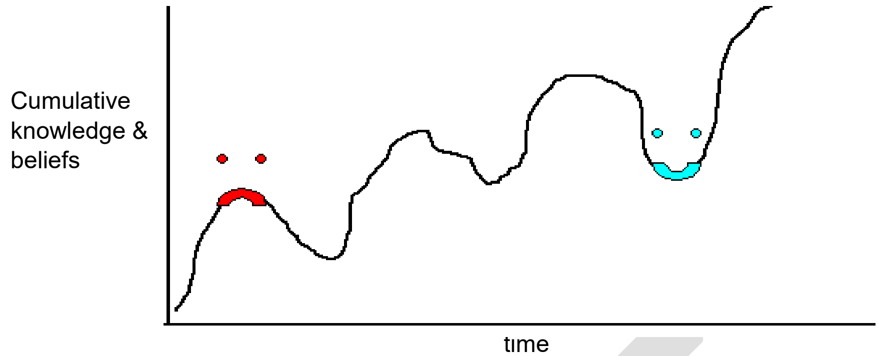

Figure 3 - Non-monotonic learning curve

Our next step is to suggests six possible emotion axes (Figure 4) that may arise while learning. Figure 3 reflects the two aspects to emotions (listed in Figure 4). One aspect is any of these emotions will occur at any moment in a person's learning journey. Understanding the cause of those occurrences can be addressed by understanding how to move a learner toward a positive affective state (toward an affective state on the right-hand side in Figure 4). The other aspect, is to consciously invoke a negative emotion in-order to motivate a learner (*e.g.*, invoke frustration and incrementally offer hints/clues so that the learner will feel confident and be motivated to move forward). Such manipulations will/can occur during a person's learning journey as depicted in Figure 2 (and in Figure 1). But it is more complex in Figure 2 (a model-based learning journey).

Axis	**-1.0**	**-0.5**		**0**	**+0.5**	**+1.0**
Anxiety-Confidence	Anxiety	Worry	Discomfort	Comfort	Hopefulness	Confidence
Ennui-Fascination	Ennui	Boredom	Indifference	Interest	Curiosity	Fascination
Frustration-Euphoria	Frustration	Puzzlement	Confusion	Insight	Enlightenment	Euphoria
Dispirited-Enthusiasm	Dispirited	Disappointed	Dissatisfied	Satisfied	Thrilled	Enthusiasm
Terror-Excitement	Terror	Dread	Apprehensive	Calm	Anticipation	Excitement
Humiliated-Proud	Humiliated	Embarrassed	Self-aware	Pleased	Satisfied	Proud
Contempt-Inspired	Contempt	Disdain	Dismissive	Appreciative	Admire	Inspired
		aversive range		**neutral**	**appetitive range**	

Figure 4 – Sets of emotions possibly relevant to learning[3]

In Figure 5 (below), the positive valence (more pleasurable) emotions are on the right; the negative valence (more unpleasant) emotions are on the left. The vertical axis is what is the Learning Axis, and symbolizes the construction of knowledge upward, and the discarding of misconceptions downward.

Learners ideally begin in Quadrant I or II: they might be curious or fascinated about a new topic of interest (Quadrant I) or they might be puzzled and motivated to reduce confusion (Quadrant II). In either case, they are in the top half of the space if their focus is on constructing or testing knowledge. Movement happens in this space as learning proceeds. For example, when solving a puzzle in *The Incredible Machine*, a learner gets a bright idea how to implement a solution and then builds a simulation. If she runs the simulation and it fails, she sees that her idea has some part that doesn't work—that needs to be diagnosed and reconstructed. At this point the she may move down into the lower half of the diagram (Quadrant III) into the 'dark teatime of the soul' while discarding misconceptions and unproductive ideas. As she consolidates her knowledge—what works and what

[3] Craig, S., *et. al* (2004) observed different affect states (frustration, boredom, flow, confusion, eureka and neutral) that potentially occur during the process of learning introductory computer literacy.

does not—with awareness of a sense of making progress, she advances to Quadrant IV. Getting another fresh idea propels the learner back into the upper half of the space (Quadrant I). Thus, a typical learning experience involves a range of emotions, cycling her around the four-quadrant cognitive-emotive space as she learns.

In Figure 5, below, we examine the four phases of any cyclical process:

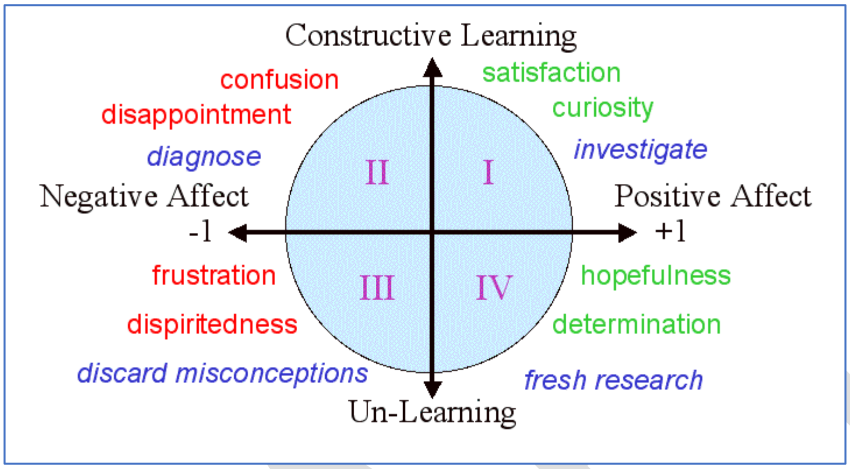

Figure 5 – Phase plane diagram relating phases of learning to emotions in Figure 2

If one visualizes a version of Figure 5 for each axis in Figure 4, then at any given instant, the learner might be in multiple Quadrants with respect to different axes. They might be in Quadrant II with respect to feeling frustrated and simultaneously in Quadrant I with respect to interest level. It is important to recognize that a range of emotions occurs naturally in a real learning process, and it is not simply the case that the positive emotions are the good ones.

We do not foresee keeping a learner in Quadrant I, but rather helping a learner appreciate that the cyclic nature is natural in learning science, mathematics, engineering, or technology (SMET), and that when a learner lands in the negative half, it is an inevitable part of the cycle. Our aim is to help learners continue orbiting the loop, teaching them to propel themselves, especially after a setback.

Let's begin by reviewing our analogy between a Learning Journey and an ordinary journey.

In ordinary Galilean motion, we typically include the following terms in our mathematical model of motion: **Time, Distance, Velocity, and Acceleration.**

When Newton invented the Calculus to systematize the study of motion, he also named the next term after Acceleration. Newton called it *Jerk*. When a car lurches, that's called Jerk in the Newtonian Calculus. And then the math geeks at MIT named the next term after Jerk; they called it *Jounce* (for Jump and Bounce).

Readers who have some background in math will appreciate where we are going with this model. We are going to analogize the ups and downs of the 'Learning Curve' (Figure 3) to the properties of a generic mathematical function that exhibits a similar roller-coaster shape.

If you study the motion of a real roller-coaster, you find that you need to keep track of four basic parameters -- Time, Distance (or Position), Velocity, and Acceleration. These four parameters are not independent. Velocity is the Time-Derivative of Position, and Acceleration is the Time-Derivative of Velocity.

Before we can go on with our Theory of Emotions and Learning, we need to review the relationship between Time, Distance, Velocity, and Acceleration in the trajectory of a moving object.

In the Calculus, when we model simple motion, we can construct a Phase Plane Diagram (Figure 5), in which Velocity is plotted against Acceleration. If you add Distance as a third axis, perpendicular to the Phase Plane, you get a three-dimensional Phase Space Model of motion, parametric in time.

Those readers who have some grounding in Calculus or Physics or Engineering may recall using Phase Plane Diagrams or Phase Space Diagrams.

For everyone else, just bear with us, as this diagram will still be helpful, even without a full appreciation of the underlying math. Try to become comfortable with reckoning a journey in terms of parameters such as Time, Distance, Velocity, and Acceleration, as we are going to analogize those to their corresponding elements in the Theory of Emotions and Learning.

Analogizing Motion (Time, Distance, Velocity and Acceleration) to the Learning Process (Time, Knowledge, Learning, and Emotions)

This section presents the most technically difficult and challenging part of the Theory of Emotions and Learning — the mathematical analogy that undergirds the Phase Plane Diagram, a concept that is central to the Calculus. For readers who are less familiar with these concepts from mathematics, it will be worth your time to explore this way of reasoning about the roller-coaster ride of the learning curve (Figure 3, above), because we are borrowing from the original thinking of Galileo and Newton.

So now, let's set up our proposed analogy between **ordinary motion** and a **learning journey**...

	Ordinary Motion	**is to**	**Learning Journey**
as	Time	is to	Time
as	Distance	is to	Knowledge
as	Velocity	is to	Learning
as	Acceleration	is to	Emotions
as	Jerk	is to	Shock
as	Jounce	is to	Resilience

Table 3 - Analogy relating ordinary motion to learning journey

Now in the Phase Plane Diagram for Ordinary Motion, we plot Velocity (on the vertical axis) against Acceleration (on the horizontal axis).

The Phase Plane divides everything into Four Quadrants. In Quadrant I (the upper right quadrant), Acceleration is Positive (you have *your pedal to the metal*), and that means your Velocity is Forward Motion and Increasing.

In Quadrant I, the Trajectory through the Phase Plane is Upwards.

In Quadrant II (the upper left quadrant), you have your foot on the brakes (or retro-rockets). That means you are slowing down your forward motion. The Trajectory through Quadrant II is Downwards.

In Quadrant III (the lower left quadrant), you are firing your braking thrusters so intensely, you are now beginning to gain speed moving backwards. The Trajectory through Quadrant III is still Downwards.

In Quadrant IV (the lower right quadrant), you once again turn on your forward thrusters, which arrest your backward motion. The Trajectory through Quadrant IV is now Upwards again.

Thus, let us envision how a learner cycles around the Phase Plane in a characteristic trajectory as the rate of learning variously accelerates or decelerates.

Recall from Table 1 above that we analogized Velocity to Learning, and Acceleration to Emotions. So now we just plug in those labels into our conventional Newtonian/Galilean Phase Plane Diagram. And that's how we arrive at Figure 5.

In Quadrant I, we have positive valence emotions (such as curiosity) as we investigate, explore, and begin to build our initial, tentative, mental models. Gosh this part is fun!

Eventually we have enough new ideas in our heads to be able to anticipate and make predictions about how things work. But wait! What's this? Do mine eyes deceive me? I just saw something surprising and unexpected, something I didn't predict. *Whazzat*? Could this be the start of confusion?

Zat is Quadrant II. Now we are really confused. We need to diagnose the discrepancy between our jejune beliefs and simple-minded expectations and what's really happening out there in that subtle and perplexing world. Suppose we've really blown it. Suppose we've adopted some cockamamie theory like 'the world is flat' or 'the rival gang down the street has a huge stockpile of secret weapons hidden in the dumpster behind the Burger King'.

Trying to navigate the world with an error-ridden map can be downright frustrating and exasperating. Arrgggh! Eventually, we're going to have to diagnose, admit, and discard such erroneous beliefs. With chagrin in our bosom and embarrassment on our faces, we move along to Quadrant III and pitch the bogonic beliefs. Lemme tellya, this is the Dark Tea-Time of the Soul. No one ever wants to admit they are traversing the Pits of Quadrant III. *Oy vey.*

But lo! There is Hope. It's over there → in Quadrant IV.

And, so with our indomitable faith, determination, and steely grit, we get-over our humiliating mistakes and hunker down to fresh research.

Einstein said, "If we knew what we were doing, we wouldn't call it Research."

Research is what we do when I don't know what I'm doing.

We do a lot of research.

Welcome to Quadrant IV.

And what do we find after a quarter century of research?

We find the Phase Plane Diagram of the Learning Journey of the Intrepid Researcher.

Or to quote our old friend, Archimedes, "Eureka! We have found it," which brings us home to Quadrant I — the Joy of Discovery Learning.

Round and round we cycle, time and again a learner travels the arduous learning curve depicted in Figure 3 (below) — the roller-coaster of life's learning journey.

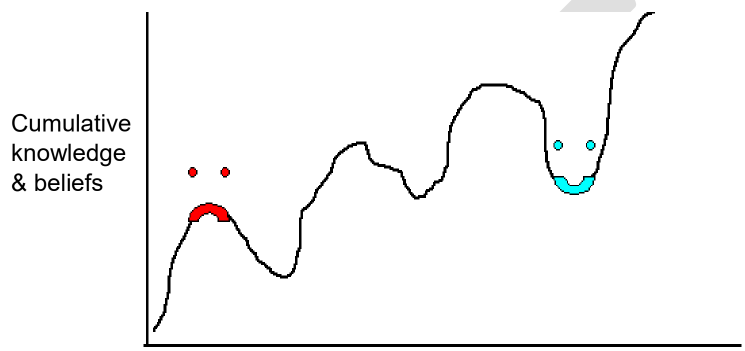

Figure 3 (repeated) - Non-monotonic learning curve

Each time around the loop, we have a net gain in total cumulative knowledge. If you add the Knowledge Axis, perpendicular to the Phase Plane of Emotions and Learning, our Trajectory looks something like the Helix of Figure 6.

A third axis (Figure 6) can be envisioned as extending out of the plane of the page—the cumulative knowledge axis. If one visualizes the above dynamics of moving from Quadrant I to II to III to IV as an orbit, then, when this third dimension is added, one obtains an excelsior spiral. In Quadrant I, anticipation and expectation are high, as the learner builds ideas and concepts and tries them out. Emotional mood decays over time either from boredom or from disappointment. In Quadrant II, the rate of construction of working knowledge diminishes, and negative emotions emerge as progress wanes. In Quadrant III, as the negative affect runs its course, the learner discards misconceptions and ideas that do not pan out. In Quadrant IV, the learner recovers hopefulness and positive attitude as the knowledge set is now cleared of unworkable and unproductive concepts, and the cycle begins anew. In building a complete and correct mental model associated with a learning opportunity, the learner may experience multiple cycles until completion of the learning exercise. Note that the orbit doesn't close on itself, but gradually spirals around the cumulative knowledge axis.

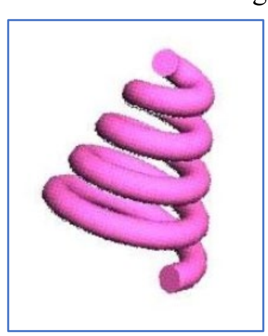

Figure 6 – The Knowledge Axis Helix flows upward and outward from Figure 5 as learning occurs

Briefly stated, each time around the loop in Figure 5, there is a net gain in total cumulative knowledge. Adding the Knowledge Axis, which is perpendicular to the Phase Plane of Emotions and Learning (Figure 5), the trajectory appears similar to the helix in Figure 6.

We appreciate that the mathematics is not exactly a cake walk, but neither is it beyond the ken of solid undergraduate curriculum. More over the main ideas can be grasped from the figures without the use of any formal mathematics training. Think of it as a methodology for metacognition to better understand the phenomenon of a learning journey.

So what role does Motivation play in all this?

> **Merriam-Webster definition of *motivation*:**
> **1:** the act or process of motivating Some students need *motivation* to help them through school.
> **2:** a motivating force, stimulus, or influence **:** INCENTIVE, DRIVE the Old Testament heroes added religious *motivation* to the waging of war— Richard Humble The fear of failure was the *motivation* for his achievements.

I'm attempting to add some pedestrian grounding to our emotions document.

But the reason for this email to is to ask your perspective on the concept of 'motivation'. From my perspective, it's a far too general phrase/concept that is employed in schools and by athletic coaches. There seems to be a general lack of understanding of what 'motivation' is and how teaching/learning/coaches employs that concept. It seems that it's just a buzz word!

I agree with you. Motivation includes both intrinsic motivation (personal interest or innate desire) and extrinsic motivation (coercion, expectations of others, or requirements imposed by governing authorities or agencies). Our own work largely ignores extrinsic factors and focuses on native emotional states that moderate or mediate the intrinsic desire or effort to learn.

Where does *cognitive assessment* fit—is it an emotional state?

Cognitive Assessment is essentially a synonym for metacognition[4] — thinking about thinking, thinking about learning and thinking about salient and subtle emotions that mediate thinking and learning.

To some extent, Cognitive Assessment is a tool for thought in the branch of Philosophy called Epistemology, which is the branch of Philosophy that asks the question, "How do we know if our beliefs and claims of knowledge are correct and true, and not lamentably undiagnosed misconceptions?"

In Science, the process of Hypothesis Testing and Peer Review employ these same tools for thought.

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[4] awareness and understanding of one's own thought processes. Examples include **planning** how to approach a learning task, using appropriate skills and strategies to solve a **problem**, monitoring one's own comprehension of text, **self**-assessing and **self**-correcting in response to the **self**-assessment, evaluating progress toward the completion of a task

The emotional component of metacognition (or Cognitive Assessment) is Intuition — that inchoate feeling that we are (or aren't) on the right track. Inchoate Intuition can evolve and mature into Express Theory. It can also be mistakenly elevated to Ungrounded, Misguided and Erroneous Beliefs.

Richard Feynman presented the process this way:

Feynman on the Scientific Method

The role of everything in a modern-day learning journey: Meaningfully *connecting the dots*

> *One of the special things about teaching is it's not just discrete skills that determine what a teacher is… It's the connection between those skills.*
>
> – Jonathan Haber, Director of Learner Assessment, Woodrow Wilson Academy of Teaching and Learning

"Many communities talk about learning… [for example] in Psychology (*e.g*., modeling, classical conditioning, Associationism, mathematical learning theory)… in Machine Learning (*e.g*., category induction, connectionism, case-based, explanation-based, Bayesian (other statistical models), genetic algorithms)… in Education (*e.g*., model-scaffold-fade, inquiry learning, constructivism, problem-based curriculum, apprenticeship learning, self-regulated learning)… in Computer learning environments (*e.g*., computer-based instruction, intelligent tutoring, interactive simulation, animated pedagogical agent, games)… but these communities do not talk to each other much; there is only about 1% overlap" (Graesser 2014).

Many excellent learning theories exist but are not comprehensive in-nature (*e.g*., Socratic Tutoring, modeling-scaffolding-fading, reciprocal teaching, building on prerequisites, sophisticated motivational techniques, scaffolding, self-regulated learning strategies), they do not address the broader question of **how people learn**.

There are several components that are in-need of deeper investigation in-order to develop a comprehensive model of how people learn. **In addition to our theory of the role of emotions in learning, these components will form a comprehensive model for the delivery of knowledge from a model-based domain**. They are:

- model-based vs. rule-based knowledge domains,
- recognizing and managing emotions (affective state),
  - deeper diving into specific emotions,
  - not one-size-fits-all,
  - cognitive dissonance,
  - mood and flow, and, mood and emotions,
  - recognizing (estimating) affective state from surface level attributes,
- Csikszentmihalyi's Zone of Flow (1990),
- conversational dialog (*e.g*., Socratic dialog).

A comprehensive model is critical to educators and to teaching-learning artifacts as they guide a person through their learning journey. Meaningful application/integration of all the components is needed.

Today, we have the skill, we have the tools to delve more deeply into how the human brain functions, how it reacts to various stimuli, we have the technology to support greater individualization of learning (as needed). We can equip a modern-day educator with the knowledge to manage a person's learning journey. But even with "current and future cognitive strategies, they won't be applicable by classroom teachers as they are too difficult to implement without the support of technology" (Graesser, 2014).

We propose to return the research agenda to a quest to understand **how people learn** (and what causes people to learn). We propose a model that is inspired by theory often used to describe complex dynamic interactions in engineering systems. As such, it is not intended to explain how learning works, but rather to provide a model for thinking and posing questions about **the role of emotions in learning**. As with any metaphor, the model has its limits. The model does not encompass all aspects of the complex interaction between emotions and learning but begins to describe some of the key phenomena in metacognition.

Our novel model and its supporting theory goes beyond previous research and existing pedagogical models not just in the range of emotions addressed, but it formalizes an analytical model that describes the dynamics of a learner's emotional states, and, does so in a language that supports metacognitive analysis.

Our *shtick*

- Organize a consortium of education researchers, cognitive psychologists, neuroscientists, *etc*. to investigate/understand the interplay between cognition, motivation, and affect in model-based knowledge domains,
- Conduct a critical review of existing research across a wide-range of sciences. There is a great deal of research that investigated emotions in learning, but that research supported gamification and/or the development of technology that served a singular purpose (*e.g*., wrist bracelet that alerted a person as to an oncoming seizure). Such research has provided great insight up-to-a-point. We propose to move beyond that point. Extending such research studies in pursuit of how people learn will lead to new insights into creating a **balanced and comprehensive pedagogical model** from which **educators can learn to accurately observe affect and apply this knowledge** on-the-spot to meaningfully aid a person during their learning journey.
- Conduct new research to:
    - create and validate functional affective interventions and strategies,
    - identify and understand meaningful positive and negative affective states that impact learning (*e.g*., curiosity, ennui, frustration. confusion, anxiety),
    - identify the gold standard of affective states.
- Extend existing research from a wide-range of sciences to evolve a new model for framing a dialogue leading to new insights and innovations that incorporate theories of affect into new or existing pedagogical models/theories.
    - We hope to attract graduate students who would pursue their thesis and dissertation work in this area,
    - We would expect to attract faculty members to contribute their expertise to this endeavor,
- Apply for funding from the Institute of Electrical and Electronics Engineers (IEEE), the National Science Foundation and other sources.
- Facilitate the creation of a body of knowledge that can be delivered to pre-service and in-service educators through a series of applied educational pedagogy courses and a fieldwork experience to recognize and appropriately apply affective pedagogical interventions to guide a person's *learning journey*.

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-------------HOLD-----------------ITEMS TO BE EXPANDED & INCLUDED IN THE MAIN TEXT------------

Cognitive Dissonance – a big disconnect

***Mood* is the penultimate factor—more powerful than an emotion (some times)**

Emotions are at the basis of learning in all knowledge domains—cognitive, affective, psychomotor!

Is *Curiosity* the gold standard of emotional states to drive learning?