

How Helping Adolescents Make Meaning from their Learning Sets Them on a Path of Purpose

Andrew Smith

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Professor Peter Taylor

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Personal change requires that we build up personal maps of meaning that make sense of life and guide us through it. Thinking is at the core of emotions; it is not the events that make us happy or miserable but our interpretation of them. Since it is our story that makes us happy or leads us to despair so it is our stories that we need to change.

-- Chris Barker and Brian Martin

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The children of this generation will experience a previously unprecedented rate of social, environmental, and economic change over the course of their lifetimes. As knowledge becomes more widely and easily accessible, individuals aiming to engage in meaningful work and social progress will require less niche subsets of knowledge, and more conceptual learning oriented skills such as critical thinking and complex problem solving. The key to preparing students to enter this kind of environment will be to create knowledge hungry, cognitively flexible people who are prepared to rapidly acquire and apply new skills throughout their lifetimes. This report details adolescent brain development and related developmental psychology theory as a means of setting some groundwork for the ways schools might help students engage in more meaningful learning toward the end of ensuring students are adequately prepared for the future. Specifically, by 1) examining neurological development characteristic to this period of human development. Because this section shows that input is more readily processed in the regions of the brain responsible for emotions, an exploration of 2) the implications for teachers and students of a learning process that's more tied to emotions and emotional processing than other period of life.

Finally, an analysis of 3) how positive emotions experienced while an adolescent learns can have profound impact on the effectiveness and meaningfulness of the learning. The report concludes with some examples of initiatives consistent with the analysis within the report, as a means of highlighting some some practical approaches for the meaningful-learning driven teacher or school administrator.

Adolescence is an unparalleled time in human development, and it's perhaps nowhere more exceptional than neurologically. For adolescents, brain growth and development has implications far beyond the realm of cognition; there are significant emotional and behavioral implications as well. A period of human development often thought of as tumultuous used to be primarily connected to 'the hormonal changes of the teenage years', but with the advent of more advanced brain imaging technologies and related research, it might more accurately be described as a period of significant neurological reconstruction (Roaten). The mechanisms that characterize this period are synaptic pruning, relatively slow prefrontal cortex development, transition and development of the midbrain limbic region, and balances of neurotransmitters which are in flux as the regions of the brain mature non-linearly. Taken individually, each of these factors can help to explain some of the characteristic elements of adolescence, including things like increased chances of depression, low capacity for empathetic reasoning, impulsivity, and emotional volatility (Roaten).

From a neurological perspective, adolescence is the second of two waves of accelerated brain development which occur during the human lifespan, the first of which is most profound and occurs prior to the age of 5. Functional Magnetic Resonance Imaging (fMRI) technology has

led to breakthroughs in the field, most generally by helping to update the understanding of the timeline and process of brain development. The process was once thought to be a mostly linear path of development with a consistent rate of growth from formation to full maturation as is more or less the case in other major body organs. However, the current understanding - as informed by fMRI technology and related research - reveals a more regional development pattern with some periods of rapid growth and change, and some more stable periods too.

The development that occurs during adolescence is characteristically permanent, the patterns established during this period will have implications which last a lifetime. Adolescence is identified in fMRI imaging by increases in white matter and decrease in gray matter density; this is the hallmark of the process of synaptic pruning (Roaten). Commonly referred to as the “use it or lose it” period of brain development, overproduction of neurons, dendrites, and synapses takes place during these years and the brain selectively eliminates those unused or under-stimulated neural pathways (Roaten). The pruning process results in stimulated pathways increasing in efficiency, like the transformation from “an unwieldy network of small pathways into a better organized system of superhighways” (Steinberg). In part, this process is the neurological backing to the theory behind exposing adolescents to a wide variety of stimulating experiences, and fostering the practice of some specialized areas of interest. Plainly, neurological pathways are set around the activities that comprise an individual’s experience of their adolescence, whether they’re watching TV or practicing cello.

Adolescent brain development is a nonlinear process, the practical implications are that adolescent processing and related behavior tends to be more emotional and impulsive than any

other period of life. After the pruning process, maturation is marked by the proliferation of a white fatty substance that insulates the neural pathways, called myelin (Roaten). Tracking myelin levels using fMRI technology is a widely practiced method of tracking the timeline and progress of brain development (Ugurbil). Research in this area has shown that one of the final areas of the brain to receive myelin - to fully mature - is the prefrontal cortex which does not reach full maturation until 25 years old (Roaten). The prefrontal cortex is the region of the brain that controls “planning, organization, insight, reasoning, and serves as a mood modulator” (Roaten). Because other areas of the brain mature and receive myelin earlier, they function more efficiently during adolescence, which causes the processes of the prefrontal cortex to be sluggish by comparison. Yurgelun-Todd et. al. help spell out the implications, “While adults rely on their prefrontal cortex to react logically to input, adolescents often rely more on the amygdala when confronted with a decision; they will revert to emotions and instinct”. The amygdala is a part of the midbrain limbic region which is also comprised of the hippocampus, together this region regulates emotions and classifies memory input.

The emotional processing that comprises the adolescent cognitive experience is, in part, reinforced by the midbrain limbic processing as the region is an active player in the body’s stress-response system. Activation of this region activates the adrenal gland to produce adrenaline and cortisol in response to stress; they are hormones which provide quick, short-term, high energy responses to stressful stimulation. As referenced, adolescence is unique in part because of the sluggish processing capacity of the prefrontal cortex and the related increased input processing handled by the amygdala and limbic system, which has a more direct

connection to the hormonal stress response system. Simply stated, the part of the brain that in adulthood moderates input before it becomes emotion is the least developed region of the brain during adolescence. While few would argue this creates a sustainable long-term system for processing stimuli, it's also the case that this neurological reality provides some powerful learning opportunities to adolescents which are not nearly as accessible to a fully mature brain.

A close neurological examination of adolescence makes it clear that learning at this stage should be thought of as an emotional experience. On this kind of learning, Greenleaf et. al. state, "Emotions, then, might be characterized as a the vehicle upon which meaning becomes attached, the canvas upon which the painting is developed and to which is adheres". Heightened emotional processing in combination with the increased excitability of chemical neurotransmitters are a major reason why there's great opportunity for deep, meaningful learning during this period. Dopamine, for example, is associated with attention, memory, learning, and executive function, and is released during and in anticipation of pleasurable experience. For adolescents, learning experiences are more apt to elicit an emotional reaction due to increased limbic system processing, and as such they're more likely to stimulate dopamine release, the result of which is deeper and more fully processed learning. While the potentially less desirable elements of this neurological environment may more easily come to mind when reflecting on the teenage experience - risk-taking behavior, emotional volatility, etc. - it's worth considering the significant, positive learning opportunities which are also present.

The rapidly changing landscape of the world of information, and especially the unprecedented availability and access to information, is a major driver of the need for individuals

to be able to engage in deep learning that results in cognitive flexibility and good thinking habits. The era of acquiring niche knowledge or specialized skills, and bring those to the marketplace as an economic model of employment, is coming to an end. Across the employment marketplace, technologies like artificial intelligence, advanced automation, and trends like advanced data analytics have disrupted knowledge based industries from driving a taxi or truck to writing law briefs to performing surgery (Shavel) (Lohr). The unprecedented abundance of knowledge has led to a knowledge devaluation effect, where the possession of specialized knowledge may previously have been very valuable, it's now much easier to store, access, and analyze even without special skills or training. As an example, consider the impact of websites like Expedia and Travelocity on the travel agent profession. Knowledge about travel deals, locations, and tips previously resided with just industry insiders, but is now crowd-sourced, free and publicly accessible in seconds. Additionally, resources like Trip Advisor, which allow users to quickly and easily post publicly available reviews and tips create a crowd generated base of travel knowledge that's highly disruptive to the prior agent-knowledge driven paradigm. The industry has had to completely pivot around this new reality.

Compounding, the abundance of access to data has led to the rapid expansion of the volume of human knowledge, such that learning geared toward knowledge-aquisition is taking a backseat to more conceptual learning. The knowledge-doubling curve is a theoretical framework developed by The Buckminster Fuller Institute in response to research which found that the rate of growth of human knowledge is no longer linear, but exponential (Schilling). The curve shows that the rate of human knowledge growth, previous to 1900, doubled roughly every century.

However, since the turn of the century the rate has growth exponentially such that it's currently doubling every 13 months. Incredibly, IBM projects that by 2025 the internet of things will lead to a knowledge doubling rate of 12 hours (Coles). With nearly incomprehensible volumes of knowable information, and instantaneous access to it, simply acquiring knowledge in a rote fashion is no longer a particularly useful skill. The Future of Jobs report compiled by the World Economic Forum predicts that the most important skills in 2020 will be complex problem solving, critical thinking, and creativity ("Future"). This set of skills is markedly different than the knowledge-based set of skills which previous generations required, and around which the traditional school format is oriented to provide. These and other related skills have several commonalities which are departures from knowledge-based learning; mastery of these skills necessitates deep, purposeful engagement and intrinsic, self-directed motivation to learn. By contrast, knowledge acquisition style learning requires less of an intellectual commitment and can more easily be stimulated by extrinsic motivating factors grades, charismatic teachers, or parental pressure. These key 21st century skills are also geared much more toward conceptual learning, than knowledge learning, this means that mastery of these skills enables the individual to engage with increasingly conceptual challenges and ideas, and not necessarily knowledge based ones.

Given the emotional processing characteristic of adolescence, motivation plays a key role in effective teaching and learning for this age group. Especially to motivate adolescents to engage in the deep and purposeful work of practicing skills like complex problem solving and creative thinking, intrinsic motivation is requisite. Vansteenkiste et. al's research in the area of

adolescent motivation extolls the effectiveness of intrinsic motivating factors, "...it promotes a more integrative and conceptual processing of the learning material, presumably because intrinsic goals, with their closer link to individuals' growth tendencies, induce a more flexible, open, and committed task engagement". Plainly, adolescents are already primed to engage with learning on an emotional level, if the nature of the learning task requires deep, motivated engagement, it seems the adolescent brain is in some ways especially equipped for the task. There's no greater intrinsic motivator than a deeply held spirit of curiosity that's targeted at engaging with ideas that are personally meaningful. This kind of motivation is a strong driver because making personally meaningful connections with a new idea only opens up a network of new questions and conceptual connections. As this landscape of meaningful connections unfolds, personal curiosity only accelerates the process of deeper exploration, connection, and reexamination.

Enjoyment of the learning process is an important aspect of adolescents' development of conceptual learning skills, and it's predicated on students feeling in control of their learning situation. When students experience positive emotions while learning, it leads to better achievement through deeper processing (Hagenauer). Roaten et. al. represent that a prominent practice among high school guidance counselors is to find avenues to maximize an student's simultaneous feelings of freedom and control. This practice is supported by research in the area of enjoyment, specifically that a students' perceived degree of control while in a learning situation is associated positively with the enjoyment-achievement pattern (Hagenauer). There are many factors in the daily lives of an average high schooler that can have a detrimental effect on

the feeling of control. An increasingly competitive college admissions environment, a national trend of high-stakes content-driven testing, and the increasingly prevalent trend of over-parenting can all lessen the feeling of control necessary for enjoyment of the learning process. Some students also experience more acute situations which go beyond decreasing just the perception of control, and impact actual daily control of circumstances such as poverty, domestic violence, and bullying.

A major incongruity between traditional schooling practices and contemporary adolescent neurological and psychological research is the traditional teacher/pupil relationship, which often establishes the teacher as a central figure of authority and control in the classroom. Learning environments where an authority figure establishes dominance and either has or is perceived to have all the control produces an external locus of causality “thereby frustrating people’s basic need for self-determination or autonomy” (Vansteenkiste). A learning situation like this one is problematic because even an instructor whose established this kind of dynamic in the classroom, but who is running ostensibly enjoyable activities, has prevented students from accessing the requisite feeling of autonomy necessarily for the kind of enjoyment that’s beneficial to learning. Project-based instruction and other careful attention to pedagogical practice can help a teacher make quick improvement in their classroom dynamic in order to correct this problem. That said, student autonomy and students making personally meaningful connections with the learning are two sides of the same coin; each impulse must come from within, and can only be fostered or encouraged by a good teacher.

Self-Efficacy is also a major determinant of an adolescent's ability to make learning meaningful. As a psychological theory, the seminal work on self-efficacy began with Albert Bandura of Stanford University and theory has been a fundamental element in many psychological fields, including educational theory. Self-efficacy is the idea that an individual's expectations about their ability to accomplish a desired outcome is a strong predictor of whether coping behavior will be applied once the task is initiated, how much effort will be expended, and for how long that effort will be expended in the face of obstacles (Bandura). Given that the conceptual learning demands of the 21st century require a deeper and more sustained effort from students, this concept is highly relevant. Self-efficacy is different than self-esteem, which is the idea that someone has a belief in their own value, rather self-efficacy is having a realistic sense of what an individual is personally capable of accomplishing. It's the idea that in the face of adversity, a person has the ability to accurately assess the task and apply concerted effort to persist through it.

Traditional school structures like grades and quizzes are antithetical to the learning needs facing 21st century learners, especially in the areas of deep processing and conceptual learning. Consider a conceptual learning task like practicing critical thinking skills, in order to truly improve these skills a student must engage with an idea, be open and vulnerable enough to persist through being wrong over and over, and be self-assured enough that their effort is unlikely to ever be rewarded with a definitively "correct" answer. The latter is perhaps the greatest sea-change from the knowledge-acquisition learning systems; when memorizing state capitals, rehearsing names of bodily structures, or practicing multiplication tables, students have

the benefit of the immediate positive feedback of getting the correct answer; Arkansas will always have a capital and there'll always be a correct answer to a quiz question about it. This kind of learning can be sustained extrinsically by a charismatic teacher and a fair grading system. However, conceptual learning lacks this same tendency; in a traditional school setting it's possible for a student to master the skill of *being a student* and to achieve good grades, but to never actually improve as a creative thinker or complex problem solver. While that may have been an acceptable outcome in the previous learning paradigm, that kind of learning situation is rapidly becoming ineffectual in the intellectual marketplace.

Schools organized around conceptual learning are likely to be almost unrecognizable by today's standard, and yet the rapid pace of change in the marketplace demands reform sooner rather than later. With the devaluation of rote knowledge acquisition, teaching and learning must pivot such that "Children who have figured out a problem, concept, or idea for themselves can talk about the why and how of the matter rather than the mere fact of its existence, and can apply what they've learned to new situations" (Lythcott-Haims). In an approaching future where a sophisticated AI system diagnoses a sick patient by instantaneously comparing their presented symptoms across a database of millions similar diagnoses, the knowledge of common symptoms becomes much less important for a practicing doctor than the ability to carefully evaluate and then apply the computer-aided diagnosis to a real world human being, crafting a plan together that will maximize the chances of a healthy outcome.

There are some strong societal forces pushing against conceptual learning, among the most troubling is the phenomenon of over-parenting, which in many ways can be seen as a

symptom of a wider societal over-valuation of extrinsic, measurable achievement rather than valuing sound thinking practices. Former Dean of Admission at Stanford University, Julia Lythcott-Haims, noticed a disturbing trend in her time at the helm of the admission process of one of the most selective learning institutions in the world. Students were arriving at Stanford with an unprecedented level of credentialing, but would fall apart when faced with seemingly minor adversity like interpersonal conflict with a roommate, a failing grade on an exam, or even more fundamental life skills problems like doing their own laundry or paying a bill. After careful analysis, her diagnosis is that the disturbing trend of over-parenting is the root cause of this problem. Over-parenting is a parenting style where parents handle nearly all of the heavy lifting of life with the theory that they're freeing up their child to focus on high academic achievement with the ultimate goal of 'success', typically as defined by admission into a highly selective university. Unfortunately, the drawbacks of this increasingly prevalent style are significant and have been found to be associated with poor life skills, psychological harm, a disturbing study-drug abuse trend, and ultimately poorer job prospects. Lythcott-Haims says:

“When parents have tended to do the stuff of life for kids—the waking up, the transporting, the reminding about deadlines and obligations, the bill paying, the question asking, the decision making, the responsibility taking, the talking to strangers, and the confronting of authorities, kids may be in for quite a shock when parents turn them loose in the world of college or work. They will experience setbacks, which will feel to them like failure. And, in a cruel twist of irony, they then won't be able to cope with that failure very well, because they haven't had much practice at failure, either”.

Clearly, this trend is counter-productive for the practice and mastery of conceptual learning skills, too. Almost by design, the style strips learning of its inherent meaningfulness.

There are a whole host of reasons why parents gravitate toward over-parenting tactics, many of which are related to the anxiety produced by a society that has a very materialistic and externally motivated concept of success. In a nutshell, the calculus is that a child's best use of time is in credentialing themselves in anticipation of college admissions standards, a process which is in many ways the ultimate extrinsic motivator. In this mindset, time is the scarcest resource and each moment must be allocated to those endeavors which are perceived to be maximally appealing to college admission boards. This means that pre-college test scores (like SAT and ACT) and high school grade point average are king, with internships at big-name companies, documentable community service, and extracurricular performance achievements are also major players. Unfortunately, since admissions offices rely on these kinds of external measurements (as it's much harder to measure conceptual learning skills) there's a flawed incentives system which rewards that which schools can easily measure, like knowledge-based exams like the SAT and ACT. Additionally, because this is where the incentives lay, entire industries have arisen to help students maximize this form of their college credentials, Lythcott-Haims reports the SAT measures "... one's ability to study for the test, which boils down to wealth. Here's how: SAT scores improve as a student studies for and retakes the tests. The more test prep and testing a student can afford, the higher their scores. This means that SAT scores correlate highly with socioeconomic status rather than cognitive ability". It's clear that the

current forces are not just failing society now, but also pushing us further away from the direction that teaching and learning must go by systematically stripping learning of meaningfulness in favor of production of easily measurable results.

The demands of the emerging future and the realities of the generation who will inherit that future are misaligned with the outcomes of the contemporary education system. That said, the need for school reform is an almost cliché refrain, with almost no one who would say the system is mostly meeting contemporary society's needs. That said, there are some very promising initiatives and trends that may hold a part of the key to more sweeping reform, that will be useful when the political and social tide changes, likely out of necessity.

Theoretically, liberal arts institutions are very well positioned to meet the demands of the future by helping students make learning purposeful and meaningful. Few would argue that in practice these institutions are consistently delivering on all their aims, but consider the underlying theory, liberal arts institutions aim, "...to prepare students with skills that are not context-specific or bound by the limitations of our current understanding of known problems but that instead are applicable to new and changing contexts, expanding knowledge bases, and emerging issues" (King). The theory reads like a precise antidote to the emerging learning needs that face students now and in the future. Theoretically, these institutions incline students toward lifelong learning, improve their moral character, teach intercultural effectiveness, and most fundamentally instill skills of integrative learning that helps a person connect information from different contexts (King). Beyond just offering a variety of curricular options, these institutions achieve these aims by building personal reflection and empathetic listening into the curriculum,

regardless of the content area. They also rely on process-oriented teaching methods that exist in concert with the neurological realities and teaching theories that maximize meaningfulness, such practices as dialogue processes and growth-oriented collaboration. While even these institutions still rely on some extrinsically motivating tools like grades, the real emphasis for the successful student of a liberal arts institution is intrinsic, graduates need to be “...people of integrity possessed of a sense of responsibility to society. These qualities require a sense of humility as well as commitment to the common good, with a conviction that there is something more important than oneself” (Thomas). The learning experience there is necessarily self-directed, students are united by their high intrinsic motivation, even if the particulars of their interest vary or are unknown, even to them. It’s a processes of learning to repeatedly make meaning from experience, to find a personal purpose among endless options, and to pursue intellectual curiosities just for the pleasure of the pursuit.

Theoretically, liberal arts institutions go a long way toward meeting the challenges of the emerging future, and yet there are many graduates who would reflect on their time fondly, but are unlikely to feel all these aims were reached. These institutions exist within the greater social and economic realities of our time. External pressures like funding, student interest, and the changing job market, have a net effect that pushes away from the core tenants of this type of institution, as defined by King et. al. and Thomas et. al. Like any other, these institutions must make compromises in order to continue to exist within a less than ideal set of circumstances. To that end, one should be cautious when looking for solutions to the problems of preparation for the teaching and learning demands of the emerging future, the aims of these kinds of institutions

may hold some of the answers, but a more fundamental social shift is a prerequisite to addressing this problem, and learning institutions are unlikely to be recognizable if that shift were to occur.

Experimentation in teaching and learning will be a key component of identifying a path forward, and some such experiments are underway now. Emerging out of the field of positive psychology, the teaching of happiness is one such example. A useful case study by Professors Chris Barker and Brian Martin out of the University of Wollongong demonstrates how preparing a course in an area like happiness raises some fundamental questions about the relationship between students and their learning institutions, and more broadly those institutions and their roles in society. For example, in conceiving the course Barker and Martin had to decide whether the purpose of the class was to gain formal knowledge about happiness theory, or was its aim the “achievement of insights and skills through which students can transform themselves and the world around them?” Furthermore, in the case of the later, can a course that endeavors to help people make themselves into happier people exist within the structures of a traditional university setting? Assessment also became a challenge, as Barker and Martin quickly realized the process of the course was social, emotional, and intellectual; with students co-constructing meaning and making personal connections that were perhaps unnoticable by the course instructor. They found the tools for assessment, even non-traditional assessment like presentations and reflection journals, were only able to assess a fraction of what seemed to be happening within the course. Ultimately, they concluded that like any other such process, that they’d stay as close to the ideal course concept as circumstances allowed, and that necessitated some compromises along the way. Experimentation in this area may seem idealistic, but consider the work in happiness and its

close ties to meaningfulness may necessitate that society finds ways to scale up this kind of learning and make it more widely accessible. “Happiness depends on just on the ‘good life’ but also the meaningful life, which involves using your signature strengths and virtues in the service of something much larger than you are. Happiness has an ethical dimension” (Seligman). It seems happiness theory is more closely in alignment with the need to help adolescents make meaning from the educational experience than is many of the other aim of contemporary educational institutions.

The aim of pivoting educational institutions toward conceptual learning skills will necessitate that many more education settings use pathways like happiness, curiosity, and meaning-making as pathways to helping their students acquire the skills necessary for the demands of the emerging future. While educational change promises to come with challenges, it’s those who embrace the change that will help the next generation navigate an unprecedented world.

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