Making sense of pedagogy

BY: PATRICK BLESSINGER

Introduction

Over the past few decades, many new teaching practices and learning methods have been developed in an attempt to improve teaching and learning at all levels. An explosion of websites, books, newsletters, journals, articles, videos, podcasts, blogs, and other publications have been produced on the different educational philosophies, teaching strategies, and learning theories related to education.

A cottage industry of consultants and companies has arisen to promote, sell, and implement many of these new ideas. There is no shortage of ideas and opinions about how to improve education. Over the course of human history, societies and schools and families around the world have tried, perhaps, every educational approach that humans can imagine, and yet, educational transformation remains elusive.

In an age where education at all levels has become extremely important and vital to a healthy society and a vibrant economy, it is no surprise that some people, including some school leaders and policy makers, may search for a "holy grail" or "silver bullet" or "magic elixir" to cure all of education's challenges and problems. Further, it is no surprise that even the field of education can be afflicted with the "flavor of the month" syndrome where wave after wave of new ideas, products, and services are touted as the next "innovation" to transform education.

However, the popularity of a theory or idea does not determine its effectiveness, and the zeal of its proponents does not make the theory or idea any more credible. Rather, any theory or idea, and the

assumptions they are based on, should be supported through sound argumentation and empirical evidence accumulated over a long period of time, across many contexts, and that tend to converge across related fields (for example, education, biology, psychology, neuroscience).

Any theory (plausible explanation supported by reasoning and evidence), model (representation of a system), taxonomy (system of classification), or strategy (plan of action to achieve a goal) should be validated with rigorous empirical data gathered over a long period of time and across many contests and implemented carefully and thoughtfully depending on the context in which it is used. When dealing with the complexity and variance of human learning and human behavior, there are no quick fixes, shortcuts, panaceas, or simple solutions.

Learning is a complex biological and psycho-social process that occurs within particular contexts.

In addition, educational philosophies, teaching strategies, and learning theories that appear to be similar are often conflated with one another, thereby ignoring key differences among those theories and strategies, and thereby creating misunderstanding and misconceptions about those philosophies, strategies, and theories. The growing list of terminology for the different philosophies, strategies, and theories can also make any discussion of the topic seem confusing or overwhelming, even for educators.

As such, people, including educators, may become discouraged about how to make sense of the explosion of information and research on pedagogy (that is, the theory and practice of teaching *children*). This confusion may then become a breeding ground for myths, gimmicks, and the like. Some teachers may resort to trial and error to figure out what works best for their classes (and may make many mistakes along the way) or they may simply try whatever idea is popular at the time (bandwagon effect).

However, trial and error, or the popularity of an idea, should not form the basis of sound instructional practices. School leadership and teacher professional development should be focused on evidence-based teaching practices that have been shown scientifically to work across a wide range of contexts over a long period of time, not on the latest tech gadgets, popular opinion, or celebrity endorsements.

Moreover, the field of education also suffers from learning myths that are deeply embedded in culture and personal belief systems and, therefore, can be very hard to dispel in the minds of people, even some educators. For instance, myths about the brain are widespread, such as the following: people only use 10% of their brain capacity, people are primarily left-brained people (analytic) or right-brained people (creative), the learning pyramid, males and females learn differently, and "brain games" improve memory and reasoning.

For example, solving logic puzzles and similar brain games will not help students become better at math. Knowledge and skills (and creativity) are knowledge domain and subject specific and are not easily transferable to other domains or subjects. Research on critical thinking shows that knowledge and critical thinking skills are grade and subject specific.

Knowledge and skills should be taught explicitly and systematically using a coherent spiral curriculum where knowledge systematically builds upon itself with each grade.

Furthermore, learning myths, exaggerated claims, clever-sounding platitudes, anecdotal claims, unfounded assumptions, emotional appeals, sweeping generalizations, and faulty reasoning, among others, can make people confounded or skeptical about which approaches tend to work best in education.

Educators should also be aware of the different cognitive biases, such as confirmation bias and groupthink, that may influence how they view different philosophies, strategies, and theories. In addition, different terms may be used interchangeably when perhaps they should not, or they may be used inappropriately.

Also, the differences, sometimes nuanced differences, between the various philosophies, theories, and strategies (for example, direct instruction vs explicit instruction) can add to the confusion and make it challenging for people to

know which approach may be most effective in a given context.

Terms may be used with a specific definition in mind (and based on certain tacit assumptions), or they may use the same or similar wording (for example, Direct Instruction (DI) vs direct instruction (di)). The explosion of research and information on teaching and learning, together with the complexity of the teaching-learning process, can create uncertainty and doubt about the most effective ways to educate children. In an environment characterized by uncertainty and doubt on one hand and pressure to improve education on the other hand, it is no surprise that some people may gravitate towards unfounded ideas.

Although it is not the intent of this article to provide a detailed description or explanation of all the varied terms and their meanings and how they relate to one another or to review all the varied strategies, theories, and models, one of the goals of this article is to provide, hopefully, some clarity and coherency on the overall topic and to elucidate some of the more pervasive misunderstandings in the area of teaching and learning. Given the importance of education to the well-being of society and to the cognitive development of humans, we need to rely on more than just conjecture, supposition, speculation, and false beliefs.

All students deserve a high-quality education that is firmly grounded in sound principles of educational research and learning science.

Given the central role that teaching and learning play within educational institutions, all of those involved in education (for example, parents, students, leaders, policymakers, researchers, and especially teachers) should be wary of educational fads, gimmicks, snake oil, ideologies, and pervasive misconceptions about learning that are not based on valid, reliable, and rigorous scientific research conducted across many contexts and over many years.

The large body of scientific research that has been accumulated over the past half-century suggests that there are qualities and characteristics that define effective teaching - teaching that supports the central organizing principle of education: to produce deep learning in students.

Important factors in teaching and learning

In the area of teaching and learning, especially at the lower grade levels (early childhood: K-2, elementary: 3-5, and middle school: 6-8), it is useful to start with the premise that excellent teaching drives effective learning and, by extension, excellent teaching requires an excellent teacher. As such, there is no substitute for a high-quality teacher delivering high-quality instruction using a high-quality curriculum.

Research suggests that the presence of a high-quality teacher is the most important factor in producing high-quality learning in students, for it is the teacher who works directly with the students on a daily basis, and it is the teacher, along with school leaders, who plans, organizes, leads, and implements the curriculum, instructional strategies, and learning activities, and it is the teacher who is primarily responsible for molding student behavior and motivation, among other teacher qualities.

In addition, research shows the other key factors that influence academic achievement in students: the student's innate academic ability and motivation, home environment, school environment and leadership, and student peers. Research suggests that about half of the variance in academic achievement in students comes from a student's own academic ability (that is, his/her innate cognitive abilities).

Apart from that factor, the teacher accounts for the largest variance in student learning. As such, when dealing with children, a teacher is much more than just a facilitator or "guide on the side" in the learning process. Effective teaching and learning require the active participation and engagement of both teachers and students, regardless of the specific teaching strategies used and learning methods employed.

Furthermore, regardless of a student's natural abilities, it is still a primary task of the teacher to get the most out of those natural abilities - that is, to instruct, guide, and mentor students in grade appropriate and subject specific ways. Therefore, schools should focus on improving the quality of teachers (and, concomitantly, the quality of the instructional process) since they are a school's most valuable asset in the teaching-learning process. It follows that providing teachers with the necessary support and resources is very important to achieve that end goal.

An excellent teacher, who knows how to deliver high-quality instruction and lead the teaching-learning process, is the most important factor in shaping an effective classroom learning environment.

Given the complexity and variance in students' backgrounds, personalities, beliefs, and dis/abilities, as well as the demands from other educational stakeholders, asking all of this from one person - the teacher - is no small task. This is why continual education and professional development are important for teachers and why teachers must be respected as professionals at every level of education. This is also why student learning must also be a community effort where all stakeholders are involved (for example, teachers, parents, leaders, and learning specialists) in shaping student behavior and expectations. Education is a team effort.

Teachers continue to grow professionally throughout the entire course of their careers. Perhaps no other career asks so much from one individual on a daily basis, and perhaps no other job has a bigger impact on the development of future citizens and on the trajectory of the nation and the world. Teaching is a profession.

As such, the archetype of the teacher as a superhero is misplaced, and perhaps detrimental, because the more that people, albeit well-intentioned, put teachers on such a lofty, and unsustainable, pedestal and believe they can move mountains or walk on water, the more likely that people will create unfair and unrealistic expectations of teachers, often subconsciously.

Also, teachers are neither self-sacrificing saints nor martyrs. Teachers are ordinary human beings who have spent many years acquiring a lot of knowledge, skills, and experience in order to be good at what they do. Excellent teachers do an extraordinary job not because they are superhuman or because they possess some mysterious X factor but because they use their hard-earned knowledge, skills, and experience to do the best job they can each day, often under challenging circumstances.

Given the complexity of the profession and the importance of producing deep learning in students, as opposed to surface learning, it is important to have a good understanding of what actually works in the teaching and learning of children.

On average, about 10% of new teachers quit the profession after their first year (this varies depending on the national context). It is important to the long-term health of a society that we attract and retain excellent teachers, many of whom work in difficult situations when educating children with unique challenges (for example, poverty, abuse, apathy, neglect, bullying, drugs, violence, poor health and nutrition, mental health problems, physical disabilities, and learning disabilities). In addition, many students also have learning difficulties like severe attention deficit and hyperactivity that impede their ability to learn which can make the task of teaching even more difficult.

About 17% of all children have some type of developmental disability. About one in six children have some type of mental health disorder such as depression, anxiety, and oppositional defiance, among others. Within this context, there has been an ongoing debate about which teaching strategies tend to work best in producing deep learning in a wide cross section of children.

To date, a lot of research has been conducted to try to assess and evaluate the various teaching strategies and learning methods in order to determine effective instructional design principles that can be applied across a variety of contexts. It is important that we continue to do research in all areas that impact education and that we continue to focus on continually improving the quality of teaching and learning.

In addition to the core factors of learning (that is, teachers, student academic ability and motivation, home environment, school environment and leadership, and student peers), grade level and subject matter also influence the teaching-learning process. Thus, an understanding of cognitive learning science, child development, and teaching-learning design principles can help guide teachers and educational leaders in how best to structure educational programs in order to meet the learning needs of all students at all levels across all subjects, including students with learning difficulties and disabilities.

What tends to work

Research suggests that direct, explicit, scaffolded instruction at the lower grade levels provides an effective way to produce deep learning in students. Direct and guided instruction provide a consistent and reliable framework through which to deliver high-quality instruction across a wide range of grades and subjects while still allowing for instructional flexibility for teachers as well as a wide range of grade and subject appropriate learning activities.

Teachers should rely on research supported teaching strategies to guide their lesson planning, including teaching students directly through instruction, provide students with multiple and varied ways to practice what they have learned in order to deepen their knowledge, and periodically and consistently assess their learning to identify knowledge gaps, misunderstandings, and errors in thinking which are then targeted for reteaching.

Direct and guided instruction is neither scripted, formulaic, nor regimented and provides children with a more organized and systematic instructional approach that is conducive to maximize learning which is important given the wide diversity of student backgrounds and learning needs. The flexibility of direct and guided instruction allows it to be used with a wide variety of teaching strategies and learning methods, such as inquiry-based learning, problem-based learning, and project-based learning, for a more well-rounded, differentiated, and targeted approach to learning.

For example, effective instructional techniques include, from structured to relatively less structured instruction, the following: presenting, explaining, modeling, demonstrating, didactic questioning, video instruction, peer instruction, guided discussion, guided practice, tutoring, group work, conferencing, reflective discussion, and dialogic questioning, among others.

Excellent teachers possess a wide array of strategies and tools to draw upon to increase deep learning in students and to adequately prepare them to be successful in doing a variety of learning activities, especially independent and group problem-solving activities, independent and group research projects, as well as independent homework assignments.

Evidence-based research suggests what tends to work in producing deep learning (for example, reading for comprehension, meaningful learning, learning by doing, collaborative learning, developing metacognitive and self-regulation skills, critical feedback, and continual formative and summative assessments) and what tends not to work in producing deep learning such as learning styles, minimally guided discovery learning, and excessive praise.

For example, many people, including educators, believe in the theory of learning styles even though there is no credible evidence to support it. For decades many schools around the world have spent resources on promoting and implementing learning styles in their schools. In spite of the fact that no credible evidence supports its effectiveness, the belief in and the practice of learning styles continues across many countries.

This practice is not only ineffective, but like many myths, its use may even be detrimental to learners. Yet, some schools of education still teach it to teacher candidates, and some states in the USA, for instance, still promote it in their licensing exams and materials. This is an example of a phenomenon that appears to be a plausible idea on the surface but a deeper analysis suggests that it does not lead to deep learning.

A student is much more likely to achieve mastery learning by developing a deep knowledge base in a subject through teacher-guided, student-centered instruction rather than students trying to discover knowledge on their own. Self-discovery in children can be haphazard and a slow process of trial and error. Children should not be left to struggle needlessly to figure out things for themselves without expert adult guidance centered around an organized and systematic curriculum.

Moreover, asking children to simply follow their own natural tendencies of curiosity is not sufficient to learn new concepts in a deep and meaningful way. To leverage that curiosity in a productive way, curiosity needs to be focused and harnessed in the right ways - this requires organized and systematic teaching, learning, and curricula that is grade and topic specific. The brain learns best when it is focused on a specific task. One effective way of doing this is by engaging children through probing questions and discussions and using other methods that get children to engage deeply with the subject matter.

Teacher-guided, student-centered instruction is based on four key components: modeling, scaffolding, mentoring, and assessment. As such, it is active, engaging, and tailored to meet the specific learning needs of students.

Research suggests that deep learning, as opposed to surface learning, requires a deep knowledge base in each subject and, all else being equal, teachers are more likely to produce that deep knowledge base in the long-term memory of students through teacher-guided, student-centered instruction using a structured curriculum.

In addition, by developing a deep subject and grade-specific knowledge base, one is more likely to develop higher-order thinking skills in that subject. Thus, building those deep subject-specific knowledge bases in students is one of the main aims of teaching and of mastery learning.

In the lower grades, most students lack the requisite mental models (schemas), knowledge base, academic skills, life experience, study habits, emotional and social maturity, etc. to learn effectively on their own without the expert guidance and knowledge of a skilled teacher and caring adult. The younger the student, all else being equal, the more structure, guidance, and intervention the student needs to help ensure he/she stays on the right track, academically, socially, psychologically, and behaviorally. The whole child must be educated.

Thus, when one acquires a deep, subject-specific knowledge base, all else being equal, the more likely he/she is to become a critical/creative thinker in the subject, and, therefore, more likely to become a good problem-solver. Creativity and problem-solving skills are subject and domain specific and thus require a large subject-specific knowledge base to draw upon. Each subject and domain has its own concepts, central organizing principles, themes, schemas, etc. that must be learned. Knowledge is foundational.

The early years are not only a critical period for brain development, but they are also a critical period for social, emotional, and behavioral development. Thus, teacher-led instruction with guided and independent practice and specific, critical feedback and assessment serves as a consistent and reliable framework for teaching across a variety of contexts.

In teaching and learning, everything depends on building a deep knowledge base in students in all

the core subjects - knowledge that is stored in long-term memory for future use.

In addition, teachers should assess and get to know their students, so they understand where each student is at, academically, personally, and otherwise. Teachers should have a good understanding of each student's knowledge and skill levels and readiness for the subject being taught (for example, benchmark assessments).

This is why school administrators, as educational leaders, and why teachers, as subject matter experts and pedagogical experts, should think carefully about which mix of teaching strategies and learning methods is most suited for their particular grade level, subject matter, learning objectives, and student readiness for the subject matter.

Thus, curricula planning (for example, content, pacing calendars, curriculum maps, lesson plans, rubrics, and assessments) is very important in teaching and learning. In addition, teaching aids such as physical manipulatives and other concrete models, as well as visual and representational models, can help students more readily understand the concepts being taught. As such, learning is enhanced and more engaging through multi-sensory representations of the content.

Research suggests that a knowledge-based curricula that is coherent and integrated across grades and subjects can be an effective element in building foundational knowledge. The curricula (content) should be grade-specific and age-appropriate. Content should be multi-modal and multi-sensory to allow for multiple means to represent content and multiple means to express and assess learning, consistent with universal design for learning (UDL) principals. The content used should be scientifically validated.

Knowledge and skills are subject and grade-specific. Mastering subject and grade-specific knowledge is necessary for students to reach higher levels of learning in those subjects.

In addition, over time, students learn how to apply their knowledge bases to increasingly complex problems and contexts through higher-order thinking skills which will allow them to not only become good consumers of knowledge but also good producers of knowledge. However, before one can become a good producer of knowledge, one must learn how to be a good consumer of knowledge.

All else being equal, the larger and deeper the knowledge base a student possesses, the better his/her cognitive processes will tend to be and the better his/her problem-solving skills will tend to be. Knowledge alone does not guarantee that a student will be a good, creative problem-solver (not a sufficient condition), but it is, nonetheless, foundational (a necessary condition), as depicted in Bloom's Taxonomy of Educational Objectives and the SOLO Taxonomy.

For any subject like reading, writing, math, and science students must first learn the building blocks of the subject in order to build a solid foundation upon which to reach higher levels of learning and critical thinking. Furthermore, it is important for teachers to have well-defined and empirically valid rubrics and standards by which to assess the quality of learning - surface learning vs deep learning.

Deep learning is best achieved with a high-quality teacher using a knowledge-based curriculum and providing critical feedback because the teacher is the one best suited to identify and correct errors in thinking and problem-solving as they occur.

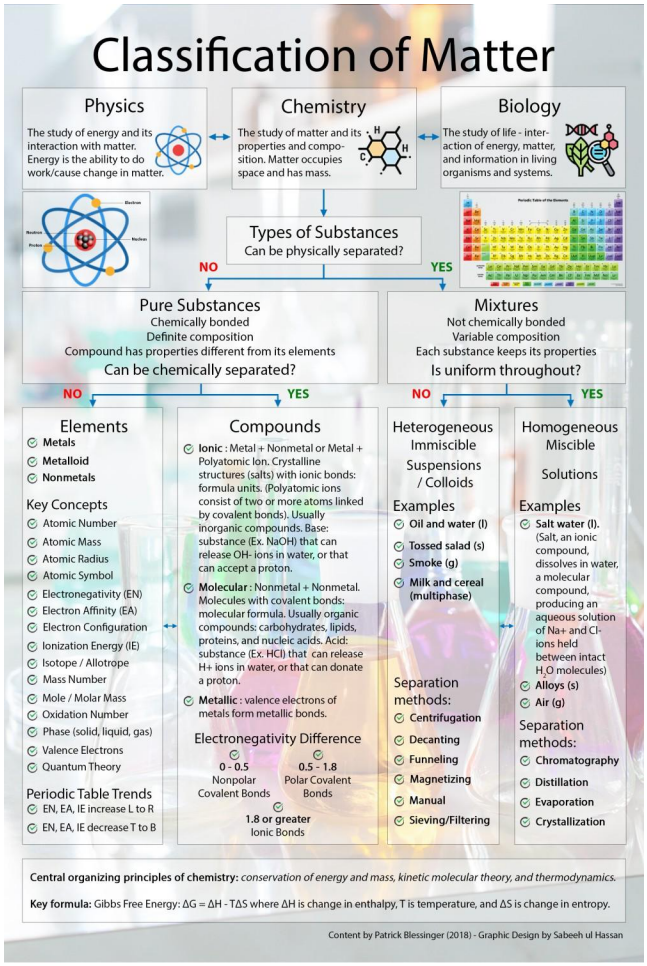
In addition, graphic organizers, anchor charts, and conceptual models, for example, provide the scaffold and the mental schemas upon which to organize and understand new concepts. Thus, putting anchor charts of key concepts on the classroom walls and as handouts help to create a more immersive learning environment which can help move the concepts into long-term memory more readily.

Furthermore, when a student's cognitive load (that is, the amount of mental effort required while thinking) is too high, learning is impeded. So, learning is improved when content is well-organized, structured, and coherent across grades and when instruction is systematic and scaffolded (providing the support and guidance needed to master a concept) and when learning is focused, reflective, and reinforced with varied types of practice. Instruction and content that is organized and coherent across grades tends to improve

understanding of the material and therefore, all else being equal, tends to improve learning outcomes. New knowledge builds on prior knowledge.

Thus, for science, for example, using direct instruction, together with inquiry-based learning (learning activities that include making observations, developing questions/hypotheses, conducting investigations, collecting/analyzing data, and proposing explanations), can provide an enhanced learning experience because a large part of science is based on the investigation of natural phenomena.

Models like the 5E model (engagement, exploration, explanation, elaboration, and evaluation), for example, provide a structured approach to science teaching and learning. In addition, the Next Generation Science Standards in the USA, which utilize the 5E model, provide an excellent approach to organize a structured and coherent science curriculum.



The nature of learning

Some schools are very diverse in their student makeup while others are less so. Some classes are highly homogenous, in terms of student demographics, abilities, and behavior, and some classes are more heterogeneous. Thus, depending on the particular mix of students, the teacher may need to adjust the instruction in different ways (for example, the way content and instruction are differentiated, the way students are grouped, and the way student seating is configured).

In short, a rational and sensible learner/learning-centered approach to instruction is focused on producing deep learning in students - learning that can be measured empirically. To that end, the teacher adjusts the teaching as students develop cognitively, emotionally, and socially over time. Thus, students are "cognitive apprentices" who learn best under the tutelage and guidance of an excellent teacher.

In addition, appropriate classroom management and student motivation strategies are important. To those ends, building academic success, and thereby academic confidence, in students is key to developing more self-regulated learners - that is, students who are capable of learning, over time, in a more independent and self-motivated way.

Perseverance, for example, is one of the key characteristics of a deep learner and it, like many other qualities, can be learned over time. This is also true of qualities like mental focus and mental stamina.

Different learning theories exist as do different teaching strategies. Learning can be considered a complex biological phenomenon as well as a complex, multifaceted psychological and sociological phenomenon, which is what makes the process of teaching and learning challenging. It should be noted, however, that learning theories are not teaching strategies. Learning theories provide insight into how learning works but a teaching strategy is broader and must draw upon other factors such as the backgrounds of students and their particular affective, behavioral, and cognitive needs.

Students need continual opportunities to learn in varied ways (for example, Universal Design for Learning - UDL) so providing multiple representations of a concept and multiple problem-solving scenarios help create deeper levels of learning in students.

Established learning theories that have been validated through empirical research over a long period of time and across many contexts provide a more holistic understanding of how learning works in the brain and provide a more holistic pedagogical repertoire for teachers to draw upon. Established theories help explain how learning works in children as they develop through the different life stages.

Learning can be defined as a change in cognition and behavior. Simply put, learning is the acquisition of knowledge, skills, and habits in response to our environment. Learning may be classified in different ways. One way is to classify learning as formal, nonformal, and informal.

Education and schooling is a type of formal learning (that is, a systematic program of learning with a structured curriculum taught by qualified teachers), although nonformal and informal (such as incidental learning) learning also occurs. This is why extracurricular activities such as music, art, sports, and clubs (for example, chess, yearbook, drama, audio-visual, and robotics) are important.

An effective teacher will know how to use research-based teaching strategies in ways that are most appropriate for his/her students in his/her given context. In short, education should provide a safe, supportive, and structured space where teachers can teach and where learners can learn. Disorganization, disorder, and distraction are not conducive to good teaching and learning. The brain learns best when it is consistently focused and on task with clear learning objectives.

We need effective and holistic ways (for example, periodic formative and summative student assessments, assignments, and projects) to help determine the depth of learning taking place in students. It is risky to assume that students have learned what they were expected to learn just because the content was taught or just because they were exposed to the content in some way or just because they say they understand the content or just because they look busy/engaged or just because they look happy. Valid and reliable assessment methods help educators measure academic achievement empirically and objectively.

Students, especially in the lower grades, need guidance, routines, boundaries, and a structured environment so they can develop good work habits and good mental discipline, especially for those students who may come from a home environment that lacks guidance, routines, and boundaries. For deep learning to occur, students require continual practice (for example, spiral learning, elaboration, retrieval practice, spaced repetition, and interleaved practice) where they are engaged in meaningful and focused learning activities. Direct and guided instruction is well-suited to give students these types of practice.

Students need caring adults and knowledgeable experts to teach and guide them directly and explicitly in what they need to know in order to build solid foundational knowledge as well as the proper habits and attitudes of mind.

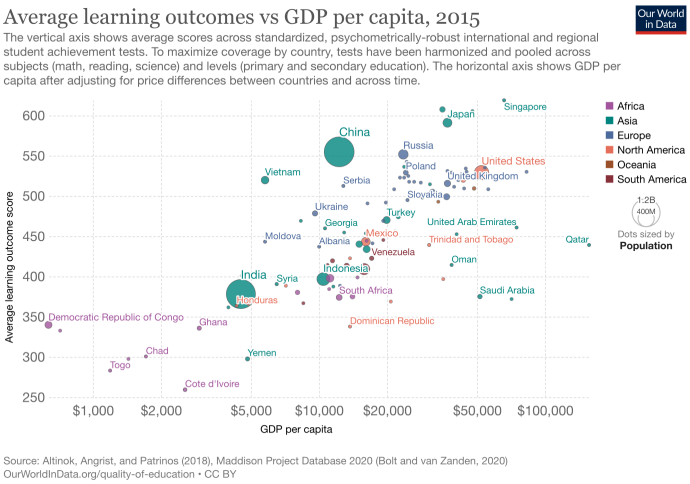
Ideally, teachers should teach in ways that are participatory, meaningful, and inclusive – that is one of the great challenges of teaching. If effective teaching was easy, then anyone could do it, but this is not the case. Excellent teaching requires years of education, training, and experience in order to effectively internalize the knowledge and skills needed to be effective. Thus, ongoing education, training, and professional development are necessary, as in any profession.

Furthermore, exceptional learners such as students with severe learning difficulties or learning disabilities require additional support to meet their particular learning needs which includes targeted response-to-intervention strategies, such as differentiated instructional strategies (tier two), or individualized educational plans (tier three). Depending on the type and severity of the learning difficulty or disability, these students may require additional support from learning specialists using a mix of strategies tailored to each student's unique needs. In short, students with special education needs require high-leverage instructional strategies.

Apart from learning the different types of knowledge (factual, conceptual, procedural, metacognitive), learners need to learn the strategies and methods needed to apply what they are learning to solve a variety of problems. Specific problem-solving strategies help develop critical thinking skills and help to make learning more meaningful and interesting.

So, for instance, when students are taking a science course, as they build content knowledge, they should also be learning how to think and behave like a scientist. When a student is taking a writing course, students should be learning how to think and behave like a good writer, and so on. This type of higher-order critical thinking and academic habits of mind should be taught explicitly.

In addition, one of the key elements in the learning process is the social interaction between the teacher(s) and the students and between the students themselves. Top-achieving societies engage in practices that tend to produce mastery learning: high academic expectations, well-defined learning standards, focus on writing, and extensive time on task in meaningful learning activities to build both knowledge and problem-solving skills. These different practices should be integrated with direct, explicit, scaffolded instruction to produce deep learning.



Source: Altinok, Angrist, and Patrinos (2018), Maddison Project Database 2020 (Bolt and van Zanden, 2020)
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The nature of teaching

Diagnostic assessments at the beginning of the academic year provide insight into students' knowledge levels and readiness for the course. Instruction should, therefore, take into account each student's background knowledge and readiness. Once the teacher has a better understanding of each student's cognitive readiness for the course and each student's particular learning needs, then the teacher can adjust the course variables accordingly, including differentiated instruction, remediation, and reteaching.

Direct instruction is often mischaracterized and misunderstood. Direct and guided instruction should not be conflated with the lecture-only model of teaching, or with the factory model of education, or with rote memorization of learning, or with passive learning. Such mischaracterizations (straw man arguments) obscure the issue. Evidence-based teaching practices like direct and guided instruction help create a more effective learning process.

Deep learning is driven by excellent teachers providing excellent instruction using excellent content within specific contexts.

Excellent teaching, therefore, becomes central to achieving academic learning objectives. Teaching is a craft that takes several years to learn effectively but each context is different. Effective learning does not happen by accident, rather, it is the result of excellent teachers delivering well-planned, high-quality instruction within specific contexts. Context matters.

Furthermore, a learning theory is not a teaching strategy. There are many learning theories. No single learning theory provides a complete view of learning. So, an effective teacher creates a strategy tailored to his/her particular situation. Evidence-based teaching strategies like direct and guided instruction provide a starting point, a foundation, and a framework through which to effectively organize and teach academic lessons.

For instance, a lesson with a brief introductory period of direct and guided instruction (say, about 15 minutes) of new concepts (teacher modeling and scaffolding together with engaged student observation, active note-taking by students, guided questioning and discussion, and critical feedback) followed by students engaged in practicing and applying the concept (say, about 30 minutes) to increasingly complex problems (mentoring,

learning-by-doing, time on task, time needed to learn) can be very efficient and effective when done in the right way by a skilled teacher.

This type of instructional model is sometimes referred to as the "I do, we do, you do" model. This type of model, when integrated with problem-based learning, can be especially beneficial for learning math. The hierarchical and problem-solving nature of math, for instance, lends itself well to direct instruction together with problem-based learning. In addition, spiral teaching using a spiral curriculum is also necessary for math learning.

Depending on the students, teachers may also need to review or reteach previous concepts in order to reinforce those concepts in long-term memory. This is a necessary part of spiral teaching and learning. Furthermore, teacher-guided instruction encourages students to work on problems collaboratively in small groups as the teacher monitors and guides their work (that is, conferencing). Teachers can then help struggling students through mentoring and critical feedback to keep them focused and on the right track.

Building math fluency (numeracy), as with language fluency (literacy), in children is very important. Math comprehension can be improved by teaching children how to use specific problem-solving strategies. Numeracy requires children to move from a concrete understanding of math (say, counting on their fingers or with physical objects) to a representational understanding of math (using pictures and drawings) to an abstract understanding of math (using symbolic notation), although all three levels can be taught at the same time to varying degrees depending on the grade level.

Conceptual and procedural knowledge are intertwined and should be taught concurrently, just as knowledge and skills are intertwined and should be learned concurrently. As they build their knowledge base in math, they also begin to understand that a math problem can be represented and solved in a variety of different ways. If delivered in the right way, direct, explicit, scaffolded instruction can be a highly efficient and effective way to build subject and grade-specific foundational knowledge.

Multiplication, for example, can be represented in several different ways: as repeated addition, as equal groups (sets), as arrays, as area models, as multiples (skip counting), as movement on a number line, as iteration, as adding partial products, as algorithms, as inverse division (product divided by factor equals factor means the same as numerator divided by denominator equals quotient), as scaling, or as a comparison.

As students become more fluent, they may even invent their own unique ways to work with numbers. Thus, teaching children directly and explicitly how to use different problem-solving strategies is important in building their math fluency.

In addition, reading comprehension can be improved by teaching children how to use specific reading strategies to improve their reading fluency. The ultimate goal of reading is comprehension (that is, to understand and interpret the multiple layers of meaning in the text).

Although reading comprehension is fundamental across all subjects, different subjects have their own unique schemas and approaches. Effective reading strategies include previewing, clarifying, inferring, predicting, contextualizing, questioning, summarizing, and using graphic organizers.

Other reading strategies include read-aloud, think-aloud, partner reading, and independent reading, among others. Reading strategies should be explicitly taught, modeled, and then practiced by students. As with any subject, students should not be left to struggle needlessly on their own with how to become effective readers and writers.

Students not only need to be taught content but they also need to be taught how to use subject-specific learning strategies for building that content in long-term memory. Direct and guided instruction is well-suited for teaching these learning strategies.

Math fluency and language fluency improve the time needed to learn new concepts by students. Ultimately, in order for students to achieve academic success and in order for students to reach a mastery level of learning, students must spend adequate time engaged in learning the content (that is, time on task) and they need continual practice in applying that knowledge to increasingly complex

problems (that is, learning by doing). All else being equal, the more time on task and the more learning by doing, the more that knowledge will be reinforced in long-term memory.

Teaching is one of the most challenging jobs in existence because the teacher has to deal with several variables at once and with variables that are continually changing – different student needs, different student personalities, different family backgrounds, different cultural backgrounds, different belief systems, different personal issues, different levels of academic readiness, different student dis/abilities, different group dynamics, among other factors – as well as the different aspects of the broader school and community environment.

Education should be inclusive and respectful of all student backgrounds to provide a more meaningful learning experience for students and thereby enhance their motivation and willingness to learn.

Thus, being a content expert is just one aspect of effective teaching. Teachers must also be pedagogical experts, classroom leaders, and student mentors, among other qualities. Teachers must also be adept at conflict resolution, mediation, and motivation, among other skills. In addition to pedagogical content knowledge (content knowledge communicated in understandable ways to the students), teachers should model the thinking and behavior they seek in their students. This is why teaching is often viewed as a craft (part art and part science) that is developed over several years of education, training, and practice.

Although direct and guided instruction is at the heart of teaching children, excellent teachers will also integrate engaging, application-oriented, collaborative learning opportunities such as labs, projects, investigations, field learning, and independent inquiry. These complementary learning activities are important because they also help create a more well-rounded, varied, and meaningful learning experience.

To that end, learning methods such as inquiry-based learning, problem-based learning, project-based learning, game-based learning, flipped learning, work-based learning, seminar-based learning, curiosity-based learning, phenomenon-based learning, case-based learning, interest-based learning, play-based learning, simulation-based learning, among others, can be useful add-ons to complement instruction and to provide varied ways to learn (UDL) if integrated into the lesson plan in the right way. It would be, perhaps, a high-risk strategy to use only one learning method across all grades and subjects.

In addition, each of the above learning methods have their own unique variations and each has its own potential benefits and drawbacks. For example, there are four types of inquiry-based learning: confirmation, structured, guided, and open. Since each of these methods has different means of implementation, mixing too many of these methods at the same time may make the lesson incoherent and muddled.

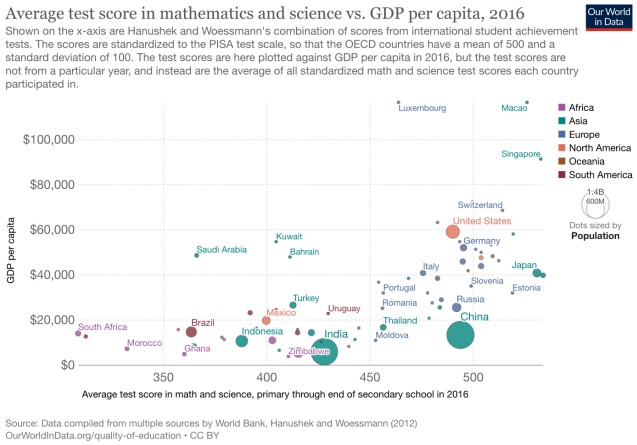
Research clearly and consistently shows that, for science, providing direct instruction in most classes coupled with strategically embedded inquiry-based instruction in some classes provides the optimal blended approach to learning science. Hence, lesson planning should be done coherently and contextually and based on assessment data.

Direct and guided instruction is well-suited to how the brain learns (that is, through chunking, modeling, scaffolding, retrieval practice, and spaced repetition) and it provides a coherent and consistent framework through which to produce mastery learning.

For example, research-validated grade and subject-specific video tutorials (for example, Khan Academy) that use direct, explicit, scaffolded instruction can help reteach and reinforce previously taught concepts and thereby reinforce long-term memory. Video-based learning, as with other learning methods, is not a substitute for an excellent teacher but it can serve as a useful complement to teacher-led instruction (for example, video tutorials assigned as homework to reinforce instructor-taught concepts).

Thus, one of the main roles of the teacher is to guide and direct the social learning process - to help motivate students to want to learn and move them toward becoming more self-regulated, master learners. This entails helping students become more self-responsible for doing the work of learning as

well as creating the right learning environment where they are guided by a high-quality teacher. Again, this is no small task.



The nature of education

As students progress through the grades, they are expected to become more self-regulating because, with each grade, they are developing a larger knowledge base, a larger skill set, more maturity, more independence, etc. When students become adults and enter college (or the workforce), students are expected to become experts in their fields because they are more capable of producing new knowledge on their own (for example, undergraduate research).

College-level students are more capable of producing new knowledge because they, presumably, have acquired enough subject-specific foundational knowledge and skills encoded in their long-term memory to work with and draw from - knowledge and skills accumulated over many years of schooling.

This is one reason why the educational philosophy of constructivism (that is, knowledge builds upon prior knowledge, and students are better able to construct new knowledge when they have a large knowledge base to work with) tends to increase in appropriateness as students get older (for example, secondary and post-secondary level) because older students have a much larger knowledge and skill base to work with and because they are more mature and self-regulating in their learning.

However, its application to young children is more challenging because young children have a smaller knowledge base to work with, they do not have well-developed mental schemas, and they are less self-regulating in their behavior and in their own learning. Nonetheless, constructivist approaches like inquiry-based learning and problem-based learning can be useful add-ons to direct and guided instruction and be beneficial in specific situations like science investigations, field learning, and research projects. Again, context is key.

Thus, one need not position the choice of pedagogical methods as an either-or proposition (that is, false choice fallacy) and one need not "throw the baby out with the bath water". The goal is to find an approach that is most effective to produce deep learning in particular contexts.

Regardless, all children in all grades in all subjects require excellent teachers to help them build their foundational knowledge and teach the concepts being learned. Children are in the process of building their foundational knowledge and therefore require consistent instruction and guidance from an expert teacher.

The central aim of instruction is to help build a deep subject and grade-specific knowledge base so that students are able to develop advanced critical and creative thinking skills.

Furthermore, this is one reason why the school model (where the student attends classes for several hours a day and does most of his/her work in the classroom under the guidance of a skilled teacher) and the higher education model (where the student attends classes for a few hours a day and does most of his/her work outside of the classroom in a more self-regulated way) are fundamentally different in how they are structured.

In essence, the models are flipped to a large degree to reflect the different stages of student learning and human development. Thus, we should not conflate the basic education model with the higher education model, and we should not conflate child learning (that is, pedagogy) with adult learning (that is, andragogy). Although learning at all levels should be meaningful and active, how this is accomplished can vary greatly depending on the grade level and subject matter and student backgrounds.

Hence, one specific instructional strategy or one specific learning method is not inherently better or

worse than another across the entire educational system, from novices to experts. It would be difficult to argue that there is only one particular teaching strategy or only one particular learning method that is inherently superior to all others for every grade level (from preschool to doctoral studies) and every learning domain (from the sciences to humanities to the arts) and every subject across the entire educational system (from pre-school to primary schools to middle schools to secondary schools to vocational/trade schools to community colleges to four-year colleges to universities), given the complexity of learning and brain development throughout the different life stages.

Each course and each lesson must be designed to meet the specific learning needs of students which can be quite varied. Thus, the application and effectiveness of any particular pedagogical approach depend, in part, on the grade level, the subject, and the learning objectives of the course, as well as the learning needs and cognitive readiness of the student(s).

Education is, by definition, a structured system of formal learning designed to develop novices into experts over a very long period of time – about 12 years at the primary, middle and secondary levels and then up to another ten years (to complete a doctorate) at the tertiary level. Since the ultimate goal of education is to produce deep learning in students, understanding the basic principles of instruction can help create a more effective educational environment.

Conclusion

To summarize, effective educational practices in the early years of learning, across the affective, behavioral, and cognitive domains, can be boiled down to three core practices: 1) direct, explicit, scaffolded instruction delivered by content and pedagogical experts to optimize the time needed to learn and to provide critical feedback to students, 2) sufficient and consistent time on task by learners through continual and varied practice and learning-by-doing to reinforce and build deep foundational knowledge and skills in long-term memory (mastery learning), and 3) a positive, meaningful, and inclusive learning environment to develop psychologically and socially mature students (well-rounded students).

Practices one and two help build knowledge and skills (cognitive development), and practice three helps build emotional and social maturity (psycho-social development) as well as create a more supportive and positive learning community. If implemented properly, these practices should increase academic achievement in students and should put students on the road to becoming more self-regulated learners.

About the Author

Patrick Blessinger is a teacher with the New York State Education Department, an adjunct associate professor of education at St John's University, New York City, USA, an adjunct instructor of education at the State University of New York (Old Westbury), and chief research scientist for the International Higher Education Teaching and Learning Association or HETL.

Suggested Citation:

Blessinger, P. (2020). Making sense of pedagogy. *Higher Education Tomorrow*. Volume 7, Article 3. http://www.patrickblessinger.com/making-sense-of-pedagogy

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