A Science of Teaching

James Paul Gee
Mary Lou Fulton Presidential Professor of Literacy Studies and Regents' Professor
Arizona State University
james.gee@asu.edu

In education over the last few decades we have progressively underplayed and undervalued teaching and instruction. This process has been abetted by liberals who celebrate "child-centered" classrooms and see overt teaching and instruction as oppressive. It is abetted by conservatives who look at teaching as no more than test prep that might better be done by a machine.

We have a well-developed field of "learning science". We know a good deal about how humans learn. Yet, really, there is no such thing as a field of "teaching science". While teaching is most certainly an art and a cultural act, it is also the subject of strong empirically-based findings about what constitutes effective teaching that leads to learning and growth. Nonetheless, when we deal with learning we tend to stress empirical findings, but when we deal with teaching we tend to stress reflection and multi-cultural tolerance. This despite the fact that the evidence would seem to indicate that meta-cognitive thinking about empirical aspects of learning and the ability to adapt strategically to individual needs and various sorts of different life affiliations are equally or more important.

Learning can, of course, occur in the absence of teaching. But in the modern world we greatly underestimate the amount, type, and importance of teaching that goes on in and out of school and the role of adults in children's learning. Over the last few years there has been a great deal of celebration of out of school learning, especially in the context of digital and social media. Much of this work makes it look like, out of school, there is a great deal of creative collaborative learning, but no teaching in the sense of instruction. However if one looks at either upper-middle class families accelerating their kids or learning on interest-driven Internet sites, this is a great deal of teaching going on. Interest-driven sites often have tutorials, lectures, mentoring, and what we in the learning sciences would call "worked examples". For some reason this aspect of digital culture has been much less studied than has learning in the digital world out of school.

Many empirically based principles about learning cannot even be stated without referencing teaching. Take feedback as an example. We know a great deal about what sorts of feedback do and not work to create good and highly motivated learning. But this means someone—who we can call a teacher—must think, in practice, about these facts and implement them strategically, with due regard for everything else going on with individual learners and classrooms. Meta-cognitively aware teachers are applied scientists.

Some people believe when young people are learning from technological tools like video games or in other sorts of technologically-enhanced learning sites that there is no teaching and, thus, evidence that we do not need teachers. They miss the fact that in any technologically-enhanced learning, the designer is a teacher, having designed into the media good principles of teaching and learning like how, why, and when to give feedback, if learning is to be effective.

Furthermore, technologies only work well in learning when they are part of larger learning systems that integrate other tools, forms of participation, and various curricular activities and forms of instruction. Such systems require teachers as implementers, assessors, and instructors, but also as system designers or, at least, system customizers (to context, learners, cultures, and individual differences).

Though liberals tend to celebrate Vygotsky, especially his ideas about the Zone of Proximal Development, they usually miss or leave out his views on instruction. Vygotsky argued that a good deal of education was based on a process of "re-regimenting" everyday concepts and language in terms of academic (and other forms of technical) language and models of thinking and dealing with the world for problem solving. For this process to work, children must have rich and extensive experiences in and with the world and with everyday language and then must engage in a "translation" process to learn how different ways of knowing the world talk about and think about the world in new and different ways. Vygotsky argued that this process required instruction. And, indeed, no more than learners can learn French if they never hear it, children cannot learn the languages of knowledge production if they do not hear them and get clear models of how they work. They get this from teachers.

Some mindless progressives have a "Build It and They Will Come" attitude toward learning. Adults just need to resource a good learning space and get out of the way and the kids will come and learn. This approach just makes the rich richer and the poor poorer. Kids who have already learned elsewhere how to be proactive deliberate strategic learners thrive and others do not. Teachers and teaching are required. The job of a teacher (and a parent) is to build a certain "type

of person", people who become proactive deliberate learners and citizens who can teach themselves and collaborate with others to make the world better.

Below I list 14 principles of good teaching. Elsewhere in my work I have listed good principles for learning. See: http://mason.gmu.edu/~lsmithg/jamespaulgee2print.html.

Here I am heavily indebted here to John Hattie and Gregory Yates' new book *Visible Learning and the Science of How We Learn* (Routledge 2013). Teaching and learning go together. The principles below are "evidence based" in the sense that they are strongly supported by evidence, not in the sense that they are strongly desired by ideology and governments.

1.   Good teachers are proactive learners about their own teaching and about what students are actually learning. Such teachers are the most factor in education.

2.   Instruction via just-in-time and on-demand talk, modelling, feedback, and design of learning experiences is necessary not optional.

3.   The ultimate goal is to produce students who are proactive deliberate learners teaching themselves or seeking out teaching from others when and where they need it.

4.   People learn from experience and need experience to learn deeply. But experience is best for learning when learners have a clear goal (which they share with a teacher or mentor)

and are taught to engage in strategic thinking and deliberate practice in their learning from experience.

5. Goals, intentions of lessons, and standards of mastery must be clear and shared by students and teachers.

6. Learners learn best—and seek and use feedback best—when they face challenges at the edge of but within their "regime of competence". Good teachers know how to manage this process for diverse leaners.

7. Feedback is not praise but actionable information that helps the student know what to do next on a trajectory of manageable steps towards mastery.

8. Deep conceptual understanding requires some knowledge of facts to start with and work with ("Yes, Virginia, facts matter"). The final goal is for the student not just to understand deeply, but to know as well how to produce knowledge and solve problems.

9. Motivation must be nurtured and nurturing motivation involves affective, cognitive, and environmental variables working together; it involves, as well, the avoidance of factors that demotivate learners. Good teachers create and manage and direct motivation.

10. A mastery orientation is better than an achievement motivation. Good teachers help learners learn to attribute success to effort not ability and engage in learning for its own sake, not just for praise, rewards, or status.

11. Good teachers align the language and values of home and of school and ensure every family gets access to the language of school (just as Vygotsky argued they should).

12. The cost of failure should not be so high that it discourages risk taking, exploration, and innovation. Failure should be seen as valued form of learning. Good teachers manage failure as a form of learning and not just assessment.

13. Peer to peer learning and peers as teachers are crucial for the eventual production of proactive deliberate learners, but peer to peer learning and teaching needs to be well structured, well designed, and well resourced.

14. Good teachers know their field (the content they are teaching) well, but understand it from a beginner's and a learner's perspective (something that "experts" are often quite bad at).

Let's think a minute about the unlikely topic of playing video games. Good gamers are "applied designers". They think at a meta-level about how a game is designed—how its rules interact—in order to leverage these rules and their interactions to accomplish their goals. Good gamers often

become "modders", that is, they learn to use software which is freely available with the game to modify and redesign the game, even design a whole new game. So, too, good teachers think at a meta-level about the design of learning and classrooms and the mod as necessary. They have a language for instruction, learning, and content. They are applied scientists and designers.

Good gamers actively seek out instruction from more advanced gamers and often seek out quite didactic strategy guides and "faq sheets". They consult digital "worked examples" on the Internet that demonstrate what good play looks like and how to solve certain sorts of problems. They play the game in a rich world of support, including all sorts of just-in-time and on-demand instruction on interest-driven Internet sites. Good teachers create classrooms that work this way, as well, with many different tools and many different forms of instruction.

It is the norm in education that when we discover something that works—works for all learners—we eventually abandon it. For example, there is plenty of evidence that "micro-teaching" works well as a tool in teacher training, but we rarely use it and even more rarely use it systematically.

To re-professionalize teaching, I believe we need the following things:

1.   A dynamic and ever-improving repository of worked examples of empirically-supported teaching. This repository should be crowd-sourced by teachers.

2.	Research on teaching that stresses empirical principles and impact in schools and in out of schools.

3.	Research on out of school teaching and not just out of school learning in families, community centers, museums, libraries, and other institutions.

4.	Research on how teaching and not just learning works with digital media and other technologies, not only as design principles but in terms of integration with other tools, forms of participation, curricular activities, and forms of instruction.

5.	Research the best ways to educate teachers as professionals and allow them to become deliberate learners of teaching and learning throughout their careers.

We have had from the National Academy of Education reports named: *How People Learn*, and *What Students Know*. We need now reports titled *How People Teach*, and *What Teachers Know*. We need not just Centers for Learning Science, but Centers for Teaching Science. Of course, we need to remember that both learning and teaching are not just cognitive processes, they are affective, cultural, and social processes, as well, and all these processes are integrated and ultimately inextricable. The science of teaching and the science of learning are not just cognitive science. They are sciences of consequential human interactions.