Table 7. Journal authorship by medal count publication points and total papers.

Author Names	Publication Points	Total Papers
Roy Clariana	14	5
Karen Swan	13	6
Xun Ge	12	5
Albert Ritzhaupt	12	5
David Passig	11	4
Roger Azevedo	10	4

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Mayer, R. E., & Johnson, C. I. (2010). Adding instructional features that promote learning in a game-like environment. *Journal of Educational Computing Research, 42*(3), 241–265.

Vogel, J. J., Vogel, D. S., Cannon-Bowers, J., Bowers, C. A., Muse, K., & Wright, M. (2006). Computer gaming and interactive simulations for learning: A meta-analysis. *Journal of Educational Computing Research, 34*(3), 229–243.

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Q & A with Ed Tech Leaders

Interview with Punya Mishra

Susan M. Fulgham
Michael F. Shaughnessy
Contributing Editors

1. What are you currently working on?

Most of my current work has focused on creativity, specifically teacher creativity and how teachers can sustain creativity in their students. Within that, of course, is the role

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that technology can play in enhancing creativity. Though there has been much written about the importance of creativity in 21st century learning, I find most of these discourses to be quite vacuous. For instance, the question I often ask is *Creativity in what domain?* One thing that is clear from the research on creativity is that creativity requires a dual-view of the world—a strong grounding in a discipline along with an ability to break out of the discipline.

So my work has focused on this issue in three main ways. First is the development of a theoretical framework on trans-disciplinary creativity, identifying ways of thinking that cut across the disciplines, since this would allow for this dual-view. Second, to conduct research to test and refine this theoretical framework. Finally, to apply this to educational contexts (for instance, in a couple of master's and doctoral courses I teach). What is interesting is how these three lines of work mutually reinforce each other—what I teach informs the frames I use for my research, which in turn feed back into how we evaluate/assess student work.

Another important aspect of my current work is its emphasis on teachers' practice. For instance, a significant amount of the research on creativity has been on the psychological and personality variables that underlie creative behavior. This information, though important from a psychological research point of view, is less useful for a teacher or educator. What is more important to a teacher or educator is understanding how to design contexts that allow for creativity on the part of the student, to develop activities and assignments that help foster creative thinking, and finally how to assess the products that students create in these contexts. We recently conducted a review of various creativity tests and found that just 4% of the research attention has been paid to evaluating contexts and products. We believe this is an important area for further work—and we are doing our bit to expand on it.

The role of aesthetics in learning mathematics and science is another strand that is just picking up. We are currently engaged in a couple of projects that seek to better understand the lived experience of scientists (specifically some of the world's top astrophysicists) and the role that aesthetics, elegance, and beauty play in how they conceptualize their work.

Finally, all these themes (creativity, design, aesthetics) come together in a series of articles I have been writing about mathematics and visual art, building on my own creative pursuits around typographical wordplay. I have been involved in this work for almost two decades now but just recently have started writing about it. I am also exited to have an exhibition of my work around this topic at the Michigan State University Museum.

2. What is the Technological Pedagogical Content Knowledge (TPACK) framework?

The TPACK framework is a framework for better understanding the kinds of knowledge that teachers need to integrate technology in their teaching. It builds on Shulman's idea of Pedagogical Content Knowledge (PCK) but adds technology as being another key knowledge component that teachers need to have. The most important thing to note here is that P, C, and T are not seen as being independent of each other; rather, it is at their intersection that

the interesting stuff happens. That's the "sweet spot" as it were—where all three come together that we see some of the best examples of technology integration.

3. What are some of the strengths and weaknesses of the TPACK framework?

There are two key contributions/strengths that I would like to speak about:

First, for educators, I think that the most important contribution of the TPACK framework is that of offering an approach for thinking intelligently about technology integration—particularly during the lesson planning process. It allows educators to ask themselves whether or not what they are doing in their classrooms truly brings together the content to be taught, the pedagogical approach being used, and the manner in which technology fits with all components.

Second, for researchers, the TPACK framework offers an analytic frame, a set of theoretical scaffolds, so to speak, to better understand teacher knowledge. It allows us to focus on key elements of the teaching-learning process (with technology) and ignore superfluous ones. The incredible flowering of research post-2006 on the construct (with over 400 articles on the TPACK Mendelay site) suggests that others have seen it the same way as well.

That said, the strength of the TPACK framework, as an abstraction, is also its greatest weakness. As all representations go, the graphic emphasizes some things but misses others. As Korzybski said "The map is not the territory." So there is no way that a simple diagram like this can capture all the complexities of teacher knowledge. What we are heartened by is the fact that critiques of the framework come in two opposite directions—either arguing that it is too simple or that it is too complex. Personally, I think it is a good place to be, suggesting that the TPACK framework is at the right level of granularity—abstract yet simple enough.

4. How do you get teachers to move past using technology as an "add-on" to lessons?

I think one of the most important lessons from the TPACK framework is that we cannot see technology as merely an "add on." The technology selected needs to match the content to be covered and the pedagogical approach being used. All three need to work together. Of course, this depends on context, since a pedagogical solution that works for a 1–1 classroom, where every learner has a device, is very different from one where learners go to a lab twice a week to work on computers. A solution that works in one instance is clearly not going to be relevant in the other. This is not to argue that one is better than the other—just that these contexts determine and guide our decision-making in profound ways. In our own work with teachers, we have argued for an approach we call deep-play, which seeks to engage teachers in constructing new ways of seeing the world, new approaches to using technologies to develop creative pedagogical solutions.

5. How do we, as teachers, guide students in turning "the right knobs" to be creative? What does it mean to be in-disciplined?

I think that creativity very often has been identified as being the domain of the gifted and talented. Of course, the Picasso's and Einstein's and T. S. Eliot's of the world have special talents that we can just be in awe of. But for the most part each of us can be (and are) creative. I value a distinction between big-C and little-c creativity made by Csikzentmihaly. So my focus has typically been on the little-c creativity—mainly because that is where most of us live and function.

I also build on Kyung Hee Kim's three-fold structure, which I have called The Creative ACT. It consists of three things: Attitude, Climate, and Thinking. So what we work on, in small steps, is all three, with the greatest emphasis on climate (since that is what is most in my control as an educator). You try and create an open, flexible environment, where taking risks and failing is not just accepted but encouraged.

The biggest task I think in getting teachers/students to be creative has to do with helping them see the world as being something one can play with, that most of the things we think of as being "rules" are actually conventions created by other humans that can be manipulated, bent, and changed. In classes I teach we start with small assignments that push people to repurpose everyday things around them, to see the world anew and then once people get comfortable with this they start seeing "knobs" everywhere (or so we hope).

As for being in-disciplined, that goes back to the idea I mentioned earlier, that being creative in a given domain requires being both knowledgeable and skilled in the domain or discipline, even while being able to break away from the domain's conventions. Our scholarship (building on some key work done by the Root-Bernsteins) shows that some of the most creative people (whether in the sciences or arts) have outside avocations that are often key to their being creative in their own fields. Incidentally, Danah Henriksen (who co-leads the deep-play research group with me) has conducted research on some of the best teachers in the country and finds that the same holds true for them as well.

6. Do Web 2.0 tools (Facebook, Twitter) promote community better than LMS tools (e-mail, discussion forums, blogs, etc.)?

Though I do believe that different tools have different affordances, I also know that it is the context within which the tools are used that is most critical. You can use a chair to sit on, as well as prop open a door (even though the chair was not designed for that purpose). So building community for me has to do with more than the tools. It has to do with shared goals (let's build this part together, or how STEM learning can be improved in our school). It has to do with ritual (whether it be a regular breakfast meeting or an annual religious ceremony). Now certain tools can help in this better than others—and I have written about this as being the "zone of possibility" of a tool. So tools don't *determine* the outcomes, but they do constrain or support certain practices, and that's what we need to factor in when we are thinking of building community (or any other educational goal, for that matter).

Personally, I tend to gravitate towards open environments—just because I think that the best learning happens when it is communal and shared, so I tend to shy away from LMS (which are often blocked out from the wider world). I also tend to prefer environments with low barriers to entry—such as Facebook, because I know most people visit it regularly—but again I use FB just for their private groups (i.e., we don't necessarily have to be friends to interact around some topics of interest).

7. Do we have the empirical research now to promote game-based learning?

This really is not an area I keep up with, so I would not be the right person to answer this. Personally, I have not been a great fan of game-based learning. I find that most times the pressure of creating engaging game-play gets in the way of accurate representation of content. Consider the game "Spore"—lots of people think that it can help teach evolution. The only problem is that Spore actually teaches Intelligent Design—since as the game maker you end up playing the role of god. So a key tension that all game-based learning designers must face is that of balancing engagement and game mechanics with the demands of the content.

I am much more interested in the idea of *play* than games. I see them as being distinct from each other—or at least play being a bigger arena than games, i.e., games as a category are a subset of a bigger category that we can play. In my view, open-ended play allows us to question the rules, while games are bound by rules. Now the fact that games are rule-bound is not necessarily a bad thing—just not one I am personally interested in. Of greater interest to me is how open-ended play is a lot about negotiation of the rules themselves. If you see how children play games when they are in groups you will see that a large part of their time goes in negotiating the rules of the game. So what this means is that play allows us to question the rules themselves, what Hofstadter calls JOOTSing (Jumping Out Of The System), while games are rule bound/constrained. It seems to me that play demands a great degree of creativity (or at the very least a different level of creativity) than happens when we play games.

8. What is the value of a theoretical framework?

I wrote about this recently on my blog, so I am just going to paraphrase from that. What a theory does is provide a structure that lets us systematically study the phenomena under question, allows us to make predictions, guides practice, and so on. Think of biology before Darwin's (and Wallace's) insights and the answer should be obvious.

In our 2006 paper introducing the TPACK (then called TPCK) framework, we got into this issue in some detail. In a section titled "What does the TPACK framework buy us?" we start with the question "What is the value of a theoretical framework?" and we answer it along three key dimensions—description, inference generation, and application. In short, theory allows us to describe phenomena based on theoretical constructs—it lets us see the world through a particular lens. It allows us to make inferences based on what we observe or the data we collect. And finally it allows us to think of how we can apply what we have learned to other contexts (something critically important to educators).

We do believe that any framework, however impover-

ished, is better than no framework at all. As Charles Darwin said "About thirty years ago there was much talk that geologists ought only to observe and not theorize; and I well remember someone saying that at this rate a man might as well go into a gravel pit and count the pebbles and describe the colors. How odd it is that anyone should not see that all observation must be for or against some view if it is to be of any service!"

9. What knowledge is of the most worth? Now, in Educational Technology, what knowledge is of the most worth?

In a 2013 paper we seek to provide an answer to this question by reviewing 15 different books, reports, etc., on 21st century learning. Our analysis shows that three key kinds of knowledge seem to be the focus of these reports: Foundational Knowledge (what we know, which includes Core Content Knowledge; Cross-Disciplinary Knowledge, and Digital/ICT Literacy); Meta Knowledge (how we act on that knowledge, and includes Creativity and Innovation, Problem Solving, and Critical Thinking; and Communication and Collaboration); and, finally, what we call Humanistic Knowledge (the values we bring to the process, and includes Life and Job Skills, Ethical and Emotional Awareness, and Cultural Competence.

One thing that stands out is that such a representation would have been true a hundred years ago—as long as we remove digital and ICT literacy. So that means that at some level nothing has changed. But we also have to understand that the pressures of globalization and technological change have also altered the landscape within which we function and has transformed each and every one of these categories and sub-categories, often quite dramatically.

10. What are the differences between teacher knowledge and technology knowledge?

Technology knowledge is knowledge of the tools and how to use them. We have argued that fluency as opposed to merely knowing the basics is important

Teacher knowledge, on the other hand, includes technology knowledge—and many other kinds of knowledge and their intersections. The TPACK framework suggests that teacher knowledge consists of three key pieces, knowledge of content, technology, and pedagogy. Clearly technology is one part of the story, but not the entire story.

11. What do you mean by "designing learning through learning to design"?

I love wordplay, and the chiasmus, where a phrase is repeated to convey meaning (Kennedy's famous statement "Ask not what your country can do for you but what you can do for your country" is a famous example of the chiasmus form). So "designing learning through learning to design" is kind of a nice way of capturing the idea of thinking of teaching as a process of design. Essentially we have argued that engaging in design (and learning to design) is an excellent way of learning to integrate technology. Thus, as teacher educators our job is to design learning environments that allow teachers (whether pre-service or in-service) to learn by design. This is connected deeply to project based learn-ing—but we prefer the phrase "learning by design" due to the multiple meanings it can evoke—the idea that design is the process by which learning occurs AND all this is being done "by design," i.e., intentionally and not by chance.

12. What is the "computer as social actor hypothesis" all about?

The computer as a social actor (CASA) hypothesis is that we often respond to technologies just as we would respond to humans. This was popularized by Nass and Reeves in their book The Media Equation. They conducted a series of studies that showed that people would be flattered by machines, would praise or blame machines, trust them, and so on. Early in my career at Michigan State I conducted some studies in this area—specifically the application of CASA hypothesis to the design of educational software. One of the studies I did shows both the power of the CASA hypothesis as well as its limitations. So participants in this study received either praise/blame for success or failure at a task. In the human-human study, people valued both kinds of feedback but in the human-computer study, people accepted praise from the computer but rejected/ignored the blame.

13. We know that a few years ago, you were invited to be a part of a symposium on etiquette (or was it netiquette). What advice would you give us on this topic?

The symposium was on software etiquette (not netiquette). It was related to expanding the CASA hypothesis to thinking of how we could design better interfaces. I explored the manner in which educational software may be rethought/reimagined if we gave credence to these values. For instance what kind of "personality" should drill and practice software demonstrate as opposed to one that focuses on open-ended play? Though I don't work in this area any more, it has been quite foundational in my thinking of how we use technology.

14. What has influenced you and how?

That's a difficult question to answer. Sometimes I think that most of my ideas emerge out of my reading and interests that I got in back in high school. Douglas Hofstadter and Borges, T. S. Eliot, and Auden formed my interests. My three years in graphic and communication design were a great influence—getting me sensitive to aesthetics and typography. In Illinois, Bill Brewer and Chip Bruce would be some of my most significant mentors. I have also been lucky to have had some great friends and colleagues ever since high school. These friends (Hartosh and Gaurav) and current ones like Matt Koehler, Leigh Wolf, and Danah Henriksen have made me better as a scholar and person than I ever thought I could be.

15. What have we neglected to ask?

This has been the most comprehensive interview ever. Great questions that made me think and reflect on my work. So thank you for the opportunity. I have created a page on my Website where people can follow and learn more about the work I am doing (or have done). You can find it by going to: ***http://punyamishra.com/***. ☐