

Inaugural Editorial for *Journal of Educational Psychology*

This is both an exciting and a challenging point in history for taking up editorship of the *Journal of Educational Psychology*. We are living through a new era of accountability in the K–12 school systems, with No Child Left Behind and a bewildering number of different standards among the states throughout the country. Most high school graduates enroll in colleges and universities, so these standards need to include deeper comprehension and writing proficiency, more advanced quantitative skills, critical thinking, and flexible reasoning strategies. We are exploring how to scale up our scientific knowledge of learning through the Institute of Education Sciences (IES), the National Science Foundation (NSF), the Department of Defense (DOD), and other funding agencies. We are in the midst of a revolution in information and computer technologies that has penetrated all sectors of society. Our workforce has a shortage of expertise in science, technology, engineering, and mathematics. Lifelong learning is becoming a priority as we face an aging population. The younger generation views the traditional classroom as an anemic alternative to the world of games, chat rooms, virtual worlds, and other electronic media. Social and sociological struggles continue to emerge from new forms of media, diverse cultures and languages, anxieties about security, changes in the global ecology, unstable economies, and wars. Education is changing, psychology is changing, and so is educational psychology.

It is important for the field of educational psychology to maintain its scientific integrity as we face the challenges of the new millennium. Our fundamental goal is to develop, test, and refine theories of the psychological mechanisms relevant to education. These mechanisms span cognition, motivation, emotion, discourse, social interaction, personality, development, neuroscience, and their complex interactions. Educational settings are inherently complex, so there is a delicate balance between preserving the methodological rigor of our research designs and testing the students in ecologically valid learning environments. We also live in an era when most educational research is conducted in interdisciplinary teams, with variations in methodological practices among disciplines. However, all scientific endeavors have both a strong empirical foundation and a compelling analytical justification for claims.

Theories and Principles of Learning

As editor, I look forward to publishing articles that test models, principles, hypotheses, and claims that are grounded theoretically. The landscape of theories is quite diverse in educational psychology, with dozens of reports prepared by research panels funded by the government. As an example, I recently had the opportunity to participate in two efforts that identified cognitive principles of learning that are supported by scientific research. One of these was a practice guide for teachers, *Organizing Instruction and Study to Improve Student Learning* (Pashler et al., 2007), an initiative of the IES in the U.S. Department of Education. The research group identified seven principles that were backed by varying degrees of empirical support:

1. Space learning over time,
2. Interleave worked example solutions with problem-solving exercises,
3. Combine graphics with verbal descriptions,
4. Connect and integrate abstract and concrete representations of concepts,
5. Use quizzing to promote learning,
6. Help students allocate study time effectively,
7. Ask deep explanatory questions.

There are concrete examples in this practice guide on how to apply these principles in the classroom. This is an important start, but there needs to be substantially more research on the conditions, contexts, and populations in which the principles will generalize. One direction for future research is to identify the situations in which there is support versus lack of support for theoretically grounded principles.

The seven principles of the IES practice guide are hardly exhaustive. There were 25 cognitive principles of learning in the other initiative, *Lifelong Learning at Work and at Home* (Graesser, Halpern, & Hakel, 2008). The Lifelong Learning initiative was launched by the Association of Psychological Sciences (APS) and an earlier joint initiative between APS and the American Psychological Association. Approximately three dozen researchers in psychology recognized the value of psychological research in guiding educational practice but also acknowledged that much of the psychological theory and research was not being applied to educational settings in K–12, colleges, and lifelong learning. The 25 principles in Table 1 were offered as a first step in scaling up contributions from psychology to the real world. These principles of learning emphasize the cognitive foundations of learning, which is perfectly appropriate, but it is important also to incorporate motivation, emotion, discourse, social interaction, personality, development, and neuroscience.

Methodologies

The mission of this journal is to report new data and empirical analyses that advance psychological theory, not to debate theoretical, philosophical, and practical questions about education. The methodologies are somewhat different among subfields and interdisciplinary teams, but it is important to have both a strong empirical foundation and a compelling analytical justification for claims. There are three methodological approaches that I expect to see in submissions under my editorship.

True Experiments With Multiple Comparison Conditions

This is arguably the ideal methodological approach in psychology. The researcher randomly assigns participants to experimental

Table 1
Twenty-five Principles of Learning

1. Contiguity Effects. Ideas that need to be associated should be presented contiguously in space and time.
2. Perceptual-Motor Grounding. Concepts benefit from being grounded in perceptual motor experiences, particularly at early stages of learning.
3. Dual Code and Multimedia Effects. Materials presented in verbal, visual, and multimedia form richer representations than a single medium.
4. Testing Effect. Testing enhances learning, particularly when the tests are aligned with important content.
5. Spacing Effect. Spaced schedules of studying and testing produce better long-term retention than a single study session or test.
6. Exam Expectations. Students benefit more from repeated testing when they expect a final exam.
7. Generation Effect. Learning is enhanced when learners produce answers compared to having them recognize answers.
8. Organization Effects. Outlining, integrating, and synthesizing information produces better learning than rereading materials or other more passive strategies.
9. Coherence Effect. Materials and multimedia should explicitly link related ideas and minimize distracting irrelevant material.
10. Stories and Example Cases. Stories and example cases tend to be remembered better than didactic facts and abstract principles.
11. Multiple Examples. An understanding of an abstract concept improves with multiple and varied examples.
12. Feedback Effects. Students benefit from feedback on their performance in a learning task, but the timing of the feedback depends on the task.
13. Negative Suggestion Effects. Learning wrong information can be reduced when feedback is immediate.
14. Desirable Difficulties. Challenges make learning and retrieval effortful and thereby have positive effects on long-term retention.
15. Manageable Cognitive Load. The information presented to the learner should not overload working memory.
16. Segmentation Principle. A complex lesson should be broken down into manageable subparts.
17. Explanation Effects. Students benefit more from constructing deep coherent explanations (mental models) of the material than memorizing shallow isolated facts.
18. Deep Questions. Students benefit more from asking and answering deep questions that elicit explanations (e.g., why, why not, how, what-if) than shallow questions (e.g., who, what, when, where).
19. Cognitive Disequilibrium. Deep reasoning and learning is stimulated by problems that create cognitive disequilibrium, such as obstacles to goals, contradictions, conflict, and anomalies.
20. Cognitive Flexibility. Cognitive flexibility improves with multiple viewpoints that link facts, skills, procedures, and deep conceptual principles.
21. Goldilocks Principle. Assignments should not be too hard or too easy, but at the right level of difficulty for the student's level of skill or prior knowledge.
22. Imperfect Metacognition. Students rarely have an accurate knowledge of their cognition, so their ability to calibrate their comprehension, learning, and memory should not be trusted.
23. Discovery Learning. Most students have trouble discovering important principles on their own, without careful guidance, scaffolding, or materials with well-crafted affordances.
24. Self-Regulated Learning. Most students need training on how to self-regulate their learning and other cognitive processes.
25. Anchored Learning. Learning is deeper and students are more motivated when the materials and skills are anchored in real-world problems that matter to the learner.

Note. Adapted from *25 Principles of Learning*, by A. C. Graesser, D. F. Halpern, and M. Hakerl, 2008, Task Force on Lifelong Learning at Work and at Home, <http://www.psyg.memphis.edu/learning/whatweknow/index.shtml>

conditions versus a variety of comparison conditions that test causal relationships between independent and dependent variables. The word *comparison* is intentionally used here, as opposed to *control condition*, because it is often the case that there is no obvious control condition that would muster agreement among researchers. One type of comparison condition is what I call the *ecological* comparison condition (i.e., business as usual), the most typical instructional program, pedagogical technique, or set of learning materials. The question is whether a new intervention would show improvements in learning or motivation compared with the ecological condition. A second type of comparison condition attempts to control for extraneous variables and identifies aspects of an intervention that are responsible for any improvements in learning gains, motivation, or other dependent measures. Unfortunately, a complex intervention would have far too many comparison conditions to assess before a researcher could assign credit to particular theoretical components, especially when interactions are assessed. Researchers are therefore forced, for practical reasons, to group theoretical components and test them as an ensemble. When taken to an extreme, researchers adopt *kitchen sink* conditions that incorporate a large number of theoretical components—so many that it is impossible to assign credit to any theoretical component in a successful intervention. My position as an editor is to encourage the use of comparison conditions that attempt to converge on theoretical components that account for successful interventions.

The acceptable designs and statistics in today's true experiments are becoming more complex in studies that assess the generality of research findings. Consider a study that tests an intervention in K–16. The statistical tests need to take into consideration that students are nested within subgroups, classrooms, teachers, schools, districts, and cities. Differences between cultures and languages have increasingly become important to consider as well. Variability within all of these levels is measured in large scale-up studies, whereas small-scale studies need at least to address problems of generalizing findings to other people and contexts. The statistically minded researchers worry about nesting in hierarchical linear models, random versus fixed effects, power, effect sizes, and variance explained by a manipulation. As editor of the journal, I acknowledge the importance of improving our standards in the statistical analyses we perform on our data. I am also sympathetic to the importance of reporting some index of the strength of a manipulation (such as effect size or variance explained). A null effect is perfectly acceptable when accompanied by suitable power analyses. Interventions that are replicated in multiple studies are preferred over a single study with exotic statistical analyses that bootstrap a hunt for significant trends.

Sophisticated Measurement Models and Psychometrics

Another mainstream tradition in educational psychology is to assess students at different points in time with a judiciously selected battery of psychometric tests and study-specific measures. A large sample of participants is needed to have adequate statistical power to perform structural equation modeling, path analysis, time series analyses, and other variants of multivariate statistics. Structural analyses that relate psychological constructs and measured variables need to be theoretically grounded and replicated. Longitudinal designs of course are highly encouraged. There will also be

a preference for designs that relate self-report measures to objective measures of behavior, cognition, emotions, and other psychological variables. Other journals are more appropriate outlets for projects that assess the reliability and construct validity of alternative self-report measures of constructs.

In the area of psychometric testing, I acknowledge the value of establishing the construct and discriminant validity of a measure through traditional item-response theory and the more contemporary evidence-centered design. A researcher who theoretically justifies a selected set of psychometric tests is preferred over a research effort that adopts a test that is status quo or that is a product of an ad hoc statistical analysis. We are in an era when psychometric tests need to be meaningfully aligned with theories of learning, pedagogy, and individual differences.

The measurement models of the future are likely to have closer ties to data mining methods that tap large data repositories. A large database might have millions of data points for a single participant over a long time span, with measures that tap behavior (physical, social, and linguistic), physiological states (brain and body), psychological states (cognition, emotion, and motivation), and the environment. There is an exciting research question of how or whether these fine-grain data sets can be integrated with psychometric measurement models. It may turn out that we need to identify or invent new mathematical models and data mining algorithms to handle large data sets.

Qualitative Research

As former editor of the journal *Discourse Processes*, I have had a rich experience reviewing manuscripts that adopt qualitative methodologies. Examples of these studies are those that collect think-aloud protocols while participants study instructional material, analyses of transcripts of naturalistic conversation, language and discourse analyses on large text corpora, detailed analyses of a small number of cases in particular discourse settings, and ethnographic studies. I am most impressed by the qualitative studies that have identifiable roots in scientific methodology. For example, researchers routinely segment verbal protocols into units, assign the units to theoretical categories, measure the number of categorized units per time period, and perform statistical tests on these quantities. That is, they quantify the qualitative data. Researchers also qualify the quantitative data by collecting verbal protocols in tandem with quantitative measures to assess the validity of the measures or to perform manipulation checks on the interventions. These are established scientific methods of integrating qualitative and quantitative analyses. Examples of scientifically inadequate qualitative studies are those in which researchers hand-pick cases that illustrate some theoretical or practical points they are advocating. The examples selected may be unusual rather than representative of a phenomenon being studied, so the theoretical and research status of such reports is uncertain. Of course,

a description of such cases plays a rhetorical function in describing and illustrating a phenomenon. This would go in the introduction and discussion sections of a study. However, such hand-picked cases do not constitute evidence to support or refute a scientific claim.

Learning Technologies and Novel Learning Environments

New computerized learning technologies are being developed at a revolutionary pace. Most of these technologies, particularly those developed in academic institutions, have a strong foundation in theory, thanks to funding from NSF, IES, DOD, and research foundations. However, there have not been a sufficient number of controlled empirical studies that assess their impact on learning, usability, motivation, and emotions.

The computer technologies of today are moving beyond the conventional computer-based training systems of the 1960s through 1980s and beyond the clicker studies for teacher-classroom interactions. Today's advanced learning environments include multimedia, hypertext-hypermedia, intelligent tutoring systems, interactive simulation, virtual reality, design environments, animated pedagogical agents, natural language dialogue facilities, computer-supported collaborative learning systems, serious games, multiparty communication spaces, and the list goes on. These advances require interdisciplinary teams with expertise in several fields: education, psychology, linguistics, artificial intelligence, the natural sciences, and the humanities.

Serious games are presumably an ideal test bed for investigating relations among learning, pedagogy, motivation, emotions, creativity, and art in our new generation of students. However, the number of empirical studies that have tested the impact of serious games on the learner is remarkably sparse. Similarly, a host of novel learning environments, many of which do not involve advanced technologies (such as learning communities), are being explored throughout the country, but there needs to be more empirical data collection that is theoretically grounded. My hope is that researchers who explore these advanced, cutting-edge technologies and learning environments will turn to the *Journal of Educational Psychology* as an outlet for their best work.

—Arthur C. Graesser, Editor

References

- Graesser, A. C., Halpern, D. F., & Hakel, M. (2008). *25 principles of learning*. Washington, DC: Task Force on Lifelong Learning at Work and at Home. Retrieved December 8, 2008, from <http://www.psync.memphis.edu/learning/whatweknow/index.shtml>
- Pashler, H., Bain, P., Bottge, B., Graesser, A., Koedinger, K., McDaniel, M., & Metcalf, J. (2007). *Organizing instruction and study to improve student learning*. Washington, DC: National Center for Education Research, Institute of Education Sciences, U.S. Department of Education. Retrieved December 8, 2008, from <http://ncer.ed.gov>