# Have You Seen This?

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*Title:* **Applying Cognitive Theory to Statistics Instruction**
*Authors:* **Marsha C Lovett & Joel B Greenhouse**
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**Summary by Peter Holmes. RSS Centre for Education**

The authors summarise five principles of learning derived from cognitive theory and four teaching techniques being recommended by the new 'reform' approach to teaching statistics. They show how they relate together, discuss the implications for teaching at university level and describe how they have incorporated them into a course in statistical reasoning at Carnegie Mellon University. The following two tables are reproduced from this article.

| *Principles of learning* | *Guidelines for instructional design* |
|---|---|
| 1. Students learn best what they practice and perform on their own | Identify the skills and subskills students are supposed to learn, and then give students opportunities to perform and practice all of those skills. Give students repeated practice at applying certain concepts or skills and time this practice so that it is spread out in time. |
| 2. Knowledge tends to be specific to the context in which it is learned | Give students problems with different contexts so they exercise what they have learned in a variety of ways. |
| 3. Learning is more efficient when students receive real-time feedback as they solve problems. | Try to "close the loop" as tightly as possible between students' thinking and the instructor's feedback. |
| 4. Learning involves integrating new knowledge with existing knowledge. | Study students' relevant initial conceptions and misconceptions and then sequence instruction to build on what students already know. |
| 5. Students' learning becomes less efficient as the mental load they must carry increases | Make the necessary information readily available to students during learning and offload extraneous processing during problem solving so that students can focus their attention on learning the material at hand. |

| *Reform Based Technique* | *Examples of Use* |
|---|---|
| Collaborative Learning | • Students work together to solve problems (e.g., Borresen 1990; Dietz 1993) or discuss concepts, sharing ideas and understanding (Garfield 1993). |
| Active learning | • Students are engaged in data collection (e.g., Rossman 1996; Scheaffer et al. 1996; Spurner et al. 1995), reflection on and exploration of statistical concepts (Lan et al. 1993), and solving problems on their own (cf. Use of technology) |
| Target misconceptions | • Instruction is designed so that students will be confronted with their misconceptions and then have the opportunity to reflect and derive a more coherent conceptual understanding (Garfield and delMas 1991). |
| Use of technology | • Several textbooks (e.g., Rossman 1996) and multimedia resources (e.g., Velleman 1996) are designed to coordinate the presentation of new material with the use of statistical software.<br>• Simulation programs allow students to explore statistical concepts in discovery-world environments (e.g., Lang, Coyne, and Wackerly 1993; Loomis and Boynton 1992; Velleman 1996). |