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GAISEing into Computer-Based Statistical Instructional Tools

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WISE
Web Interface for Statistical Education

About the WISE Project

The WISE Project provides Internet-based tutorials to supplement the teaching of core statistical concepts. Tutorials include interactive Java applets, guided demonstrations, questions with feedback, and "thought" questions to test student understanding and guide classroom discussion.

Interested faculty can use our tutorials as laboratory exercises, homework assignments, or in-class demonstrations.

CONTACT

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Statistics Education Guidelines

The Guidelines for Assessment and Instruction in Statistics Education Project (http://www.amstat.org/education/gaise/) provides recommendations for improving statistics instruction in both K-12 and introductory college courses. For college courses, these recommendations are:

G1) Emphasize statistical literacy and develop statistical thinking;

G2) Use real data;

G3) Stress conceptual understanding, rather than mere knowledge of procedures;

G4) Foster active learning in the classroom;

G5) Use technology for developing concepts and analyzing data;

G6) Use assessments to improve and evaluate student learning.

Focusing on Computer-Based Instruction (CBI)

The rapid growth of technology use in teaching statistics raises questions regarding:

1) The extent to which the GAISE principles are incorporated in computer-based instruction (CBI) compared to traditional instruction;

2) Whether CBI implementation of the GAISE recommendations is associated with better learning.

Examples of CBI include: SPSS and Excel, Web-based courses, computer simulations, CD-ROMs, or online tutorials.

Rating Traditional and CBI Instruction

An exhaustive search of the literature through 2009 identified 56 studies of statistics education that compared CBI with traditional instruction that used little or no technology.

For each study, we rated the extent to which the CBI condition conformed to each GAISE recommendation, with separate ratings for statistical literacy and statistical thinking, omitting use of technology (all CBI used technology).

We also rated the extent to which:

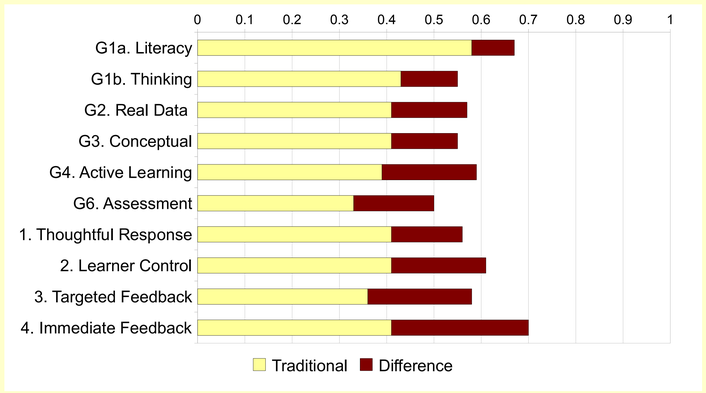
1) Thoughtful responses were required
2) Learner control was required
3) Feedback was targeted to the learners' responses
4) Immediate feedback was provided

For each of the 10 attributes, we rated both the CBI condition and the difference between CBI and traditional condition (a 0-1 scale).

We also computed learning outcome differences (*d*) between CBI and traditional instruction groups.

CBI: Greater Extent of GAISE Implementation

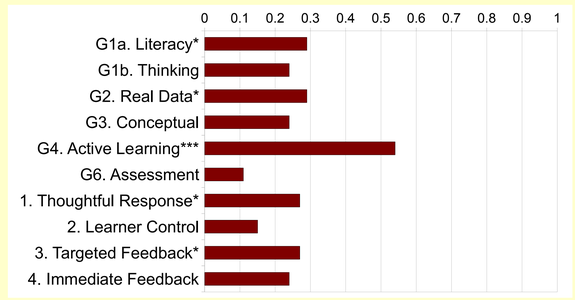
The figure below shows the extent to which each of the attributes was present in the traditional condition (inferred) and difference between the CBI and traditional condition.



➢ All ten of the instructional attributes were observed in CBI (represented by the whole line) to a greater extent than in traditional instruction.

Differences Related to Learning

The figure below shows the correlation, *r*, between Difference scores and learning outcomes.

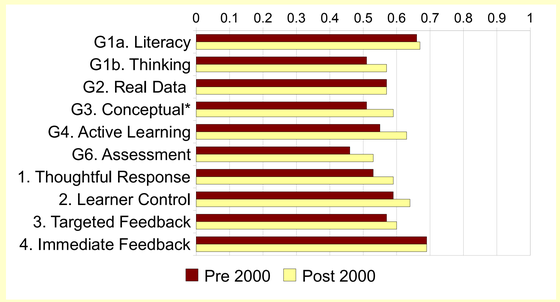


➢ All ten Difference attributes demonstrated positive correlations with learning outcomes;

➢ The greater the difference between the CBI and traditional instruction conditions, the greater the difference in learning (*d*).

Changes in CBI Implementation

We also examined the extent to which the CBI implementation of the GAISE principles in has changed, comparing studies published before 2000 ($k = 28$) and 2000 and after ($k = 28$).



➢ Although there has been a general increase in applying the GAISE principles, only one increase attained statistical significance: G3) Stress conceptual understanding rather than mere knowledge of procedures, $t(54) = 2.16$, $p = .035$.