

# **The Interaction Plateau: Answer-Based Tutoring < Step-Based Tutoring = Natural Tutoring**

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Face-to-face tutoring by an expert human tutor is widely thought to be more effective than intelligent tutoring systems (ITS), which are in turn thought to be more effective than computer-aided instruction (CAI), computer-based training (CBT), etc. The latter tutoring systems have students work out complex solutions on paper, then enter their answer into the tutor, which gives them feedback and hints on their answer. Thus, CAI, CBT, etc. are answer-based tutoring systems. This is a low level of interactivity, in that the student may make many inferences between the time they start the problem and when they first get feedback on their thinking. With a typical ITS, such as the Andes physics tutoring system, students enter every step of a complex solution into the tutor, which gives them feedback and hints, either immediately or when they have finished entering all the steps. These systems are step-based tutoring systems, because the feedback and hints are directed at steps rather than the final answer. They are moderately interactive, because students make a moderate number of inferences per step. When interacting face-to-face with a human tutor, students often talk aloud as they reason, and thus allow the tutor to hear and intervene at almost every inference made by the student. Thus, human tutoring is highly interactive. Natural language tutoring systems, such as Why2-Atlas and Cordillera, are engineered to act like human tutors, so they too are highly interactive. If we use “natural tutoring” to cover both human tutoring and natural language tutoring, then the three types of tutoring can be ordered:

answer-based tutoring < step-based tutoring < natural tutoring

This certainly holds for their degree of interactivity, as just argued. This is also thought to be the ordering for their learning effectiveness. Moreover, it is sometimes thought that higher interactivity affords or perhaps even causes higher learning gains.

This talk will debunk that myth. In particular, experiments with human and computer tutors usually find that learning gains are ordered this way:

answer-based tutoring < step-based tutoring = natural tutoring

Increasing interactivity beyond the step level appears to neither afford nor cause higher learning gains.