# Using *Inspiration 6*® in Introductory Statistics: A Preliminary Report

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**Abstract**
Teachers or researchers can develop their own assessment instruments using *Inspiration 6*® which is a computerized visual learning tool that inspires students to develop and organize their ideas. It supports visual thinking techniques, enabling students to easily create and update concept maps. This study used the concept maps to evaluate progress in high-order reasoning skills in elementary statistics. Female students from a high school SummerMath program brainstormed, reasoned and created maps linking basic statistical terms and ideas, differences in knowledge, design and organization emerged. Such maps provided valuable diagnostic information essential to good teaching.
Students incorporated prior knowledge into their concept maps and revealed conceptions that were later better developed. While factual recall and application are standard methods for assessing statistical understanding, little is known about the ways in which students make connections between statistical concepts. The present research sought to identify various connections within students' statistical understanding. The computerized constructions provided the interface upon which students and teachers could co-construct statistical models and methods.
Understanding a new concept involves a process of integrating new information with current models of the world. The self creates a new and different world through cognitive construction-the act of creating and refining usable models. With this perspective on teaching and learning, the instructor plays a key role by providing experiences and helping the students to build complex mental models compatible with textbook explanations and their applications to daily life. These activities may take the form of a dialogue or conversation through which the instructor and the students suggest, construct and exchange ideas to produce mental models in basic statistics.
Unfortunately, many students have difficulty building and communicating mental models of basic statistics. It may be that some of this difficulty in developing mental models is due to students' inability to integrate text information with everyday usage. While statisticians hold complex statistical models, beginning students' knowledge is often rote and not readily transferable. One method for attaching meaning to statistics terms is through a concept map. To produce this map, teachers ask students to create visual displays using *Inspiration 6*® which is a computerized tool that inspires students to develop and organize their ideas. Students easily create and update concept maps to help focus on their ideas. Visual learning techniques such as concept maps help students to process and retain new information by making connections between new and existing knowledge.

Through the process of creating and sharing concept maps, students provide very rich descriptions of current understanding. Teachers can thus better engage students in conversation and progress the learning through a Co-Construction process. In the Co-Construction process, after students draw their initial concept maps, the instructor provides the students with guidance crucial to the building of improved models. The guidance takes the form of a dialogue in which the instructor probes the students' ideas on an individual basis. Then, instead of presenting the students with the statistical model, as likely in traditional teaching, the instructor confronts the students with successive counterarguments and constraints that stimulate the students to review and modify their evolving ideas.

Whereas beginning students' knowledge base consist of isolated bits of information reflecting a shallow understanding of concepts and their interrelationships. Improved understanding may be conceptualized as an appropriately integrated and organized structure of the statistical concepts. Valuable assessments of students' thinking include examining the understandings and models that students construct during the learning process. Resnick *et al.* (1993) examined expertise of these structures through the number and types of concepts depicted, the number and types of relationships among concepts (including conditional and hierarchical), and the degree of organization. Other aspects of expert performance include: organization of knowledge; meaningful patterns; understanding of statistical options; self-monitoring skills (Chi, Glaser & Rees, 1982). These findings on the character of expertise can serve as a basis for the integration of cognitive theory with evaluative tools that assess growing proficiency in Statistics.

Are student relational concept maps produced on a computer a viable method to engage students and if so, what patterns might we see? With *Inspiration 6®*, I gathered student data on statistical understanding. In the study, I explored how 8 high school women reasoned and communicated ideas about typicality and variability of data. Each class meeting, I asked students to reflect and shared their understanding of statistical tasks in which they produced student surveys, collected and then analyzed data. We based class discussions on what students needed in order to complete these tasks. When students finished tasks in the beginning and program end, student pairs discussed and drew concept maps. From the resulting concept maps produced at the end of the program, most students began with some simple conceptions that later became more interlinked and complex.

## Overview of the Class Content

As a SummerMath instructor at Mount Holyoke College, I evaluated student gains in order to direct ongoing instruction in central measures-a fundamental of statistical reasoning. I was interested in how students developed models and how they employed these models to explain data generated from student surveys on teenage behaviors.

### *Participants*

At Mount Holyoke College's Summermath, a 2-week workshop class containing a diverse mix of young women ages 14-17, met daily for 1.5 hours to provide a forum discussing data collection, central measures and variability. The researcher was the instructor. The class of 14 female students had mixed distribution of ethnicities, grade level, and abilities. The class size self-divided into high and lower level students. Both groups contained 50% black-white racial mixtures. While there was some informality, the class content and general outline was directed by the instructor. Students were encouraged to talk, discuss, and argue in both their small group discussions and in the whole class interaction. Students were verbally encouraged to come with their prior conceptions, pieces of knowledge, beliefs, and misconceptions.

Students began and ended with conceptual maps linking their self-generated statistical topics. They investigated and discussed common themes of data collection, organization, presentation, and analysis through creating and collecting Summermath student surveys. Using this hands-on approach, many of the real-life problems of randomness, sample selection, survey bias appeared. We discussed these issues along with measurement choices that can highlight certain opinions. We also discussed causal relationships through strong correlation, plausibility, replication, direct variation, and computerized cross tab analyses.

### *Data Collection*

The class described in this study took place in at Mount Holyoke College's computer laboratory. Using an Inspiration 6® file, students provided a spatial display of their knowledge structures including the concepts, connections among concepts, and the relationships underlying the connections. Students used Inspiration 6® to provide a spatial display of their knowledge structures including the concepts, connections among concepts, and the relationships underlying the connections. The student pair moved the concepts in the boxes around the screen to depict how they were associated. The pair then connected the concepts by lines to show the linkages the student perceived. Finally, they entered words on the lines to describe the nature of the linkages or relationships.

### *Results and Conclusions*

Arguably students can tell you what they know in written tasks and verbal questioning. Teachers can also gather information through prompted interviews. However, computer programs like Inspiration 6® can provide a unique and feasible method to get at student understanding. The key issue is feasibility particularly in large classes where such direct measures of student understanding are less likely to occur. Using technology and existing software available at reasonable cost, teachers can apply valid ongoing measures that support new learning theories.

At times, students themselves are at a loss of words to describe what they do or do not understand in learning Statistics. But the accent on visual thinking and technology allows students to put descriptors on that which they cannot say clearly in text and words. Through a Co-Construction process in conjunction with the computerized concept maps, students were processing statistical and real-life connections. This is a challenging task at any cognitive level.

The number of linkages and the complexity of the concept relations from the pre to post maps is a viable method of assessing gains in a students' knowledge structure. While Rye (2002) expressed concern about concept map scoring systems and their associated validity and reliability, I suggest such less formal measures to encourage teacher use. He favored methods that employ expert/criterion maps as referents and emphasize the use of accurate concept relationships in deriving scores, which have been found to correlate with performance on standardized tests. Though psychometrically appealing, my interest in using the concept maps focused on improving student connections among the statistic terms. Perhaps as a continuation of the present research, more data collection on student criterion measures is needed. Rather than contrast expert-novice maps and measuring correlates to standard measures, I employed the concept maps to engage Co-Construction. Through the process of producing these maps, students develop self-regulatory processes that improve cognitive skills. These cognitive skills are manifested by number of concept linkages, by the allocation of attention as shown through the student details, and by sensitivity to informational feedback with teacher.

## Concept Maps

Low abilities
PRE-TEACHING: 3 linear concepts which show limited knowledge by the few concepts represented
POST-TEACHING: 4 concepts arranged with the beginning hierarchical understanding

Middle ability
PRE-TEACHING: 10 concepts with some basic understanding and reasonable connections prior to data collection
POST-TEACHING-11 concepts (some different) with no linkages suggesting more confusions following more terms and data

Middle ability
PRE-TEACHING: 17 concepts with more terms but terms are listed via one linkage from statistics-no hierarchical or order displayed
POST-TEACHING: 27 concepts with more inter-connected system. Sub-categories and present and linked in hierarchical manner

High ability
PRE-TEACHING: 12 concepts with appropriate terminology. Not linked but spaced in appropriate region
POST-TEACHING: 19 concepts with increased understanding of terms like inference and distinguishing more advanced statistical topics

## REFERENCES

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