Evaluating student learning gains from illustration of course concepts in 2D and 3D online collaborative environments

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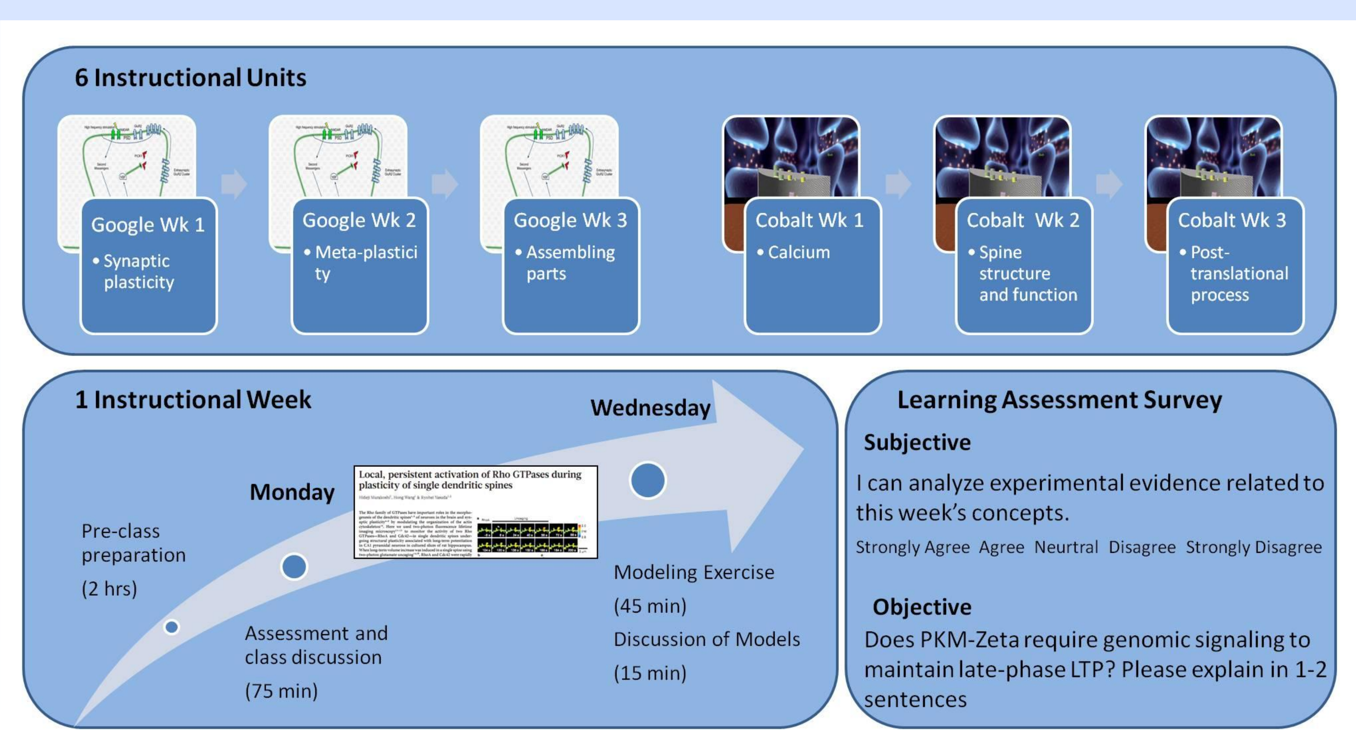
1. Introduction

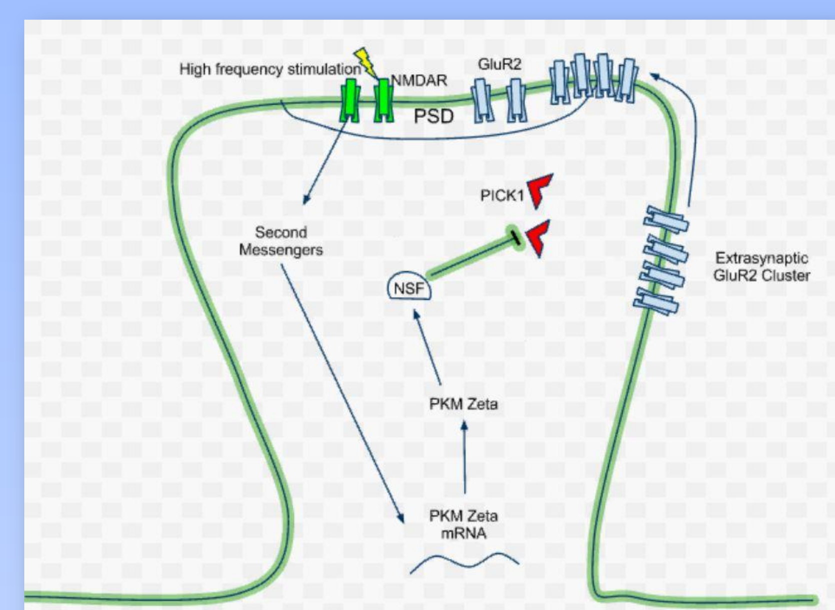
Explaining complex cellular phenomena in lecture format is a challenge for neuroscience educators. Students are also challenged to express their understanding of course concepts and receive feedback, primarily through text-based assessments. In an undergraduate neuroscience course, we evaluate how learning is affected when groups of students construct visual explanations of course concepts in two-dimensional (2D) and three-dimensional (3D) online collaborative environments.

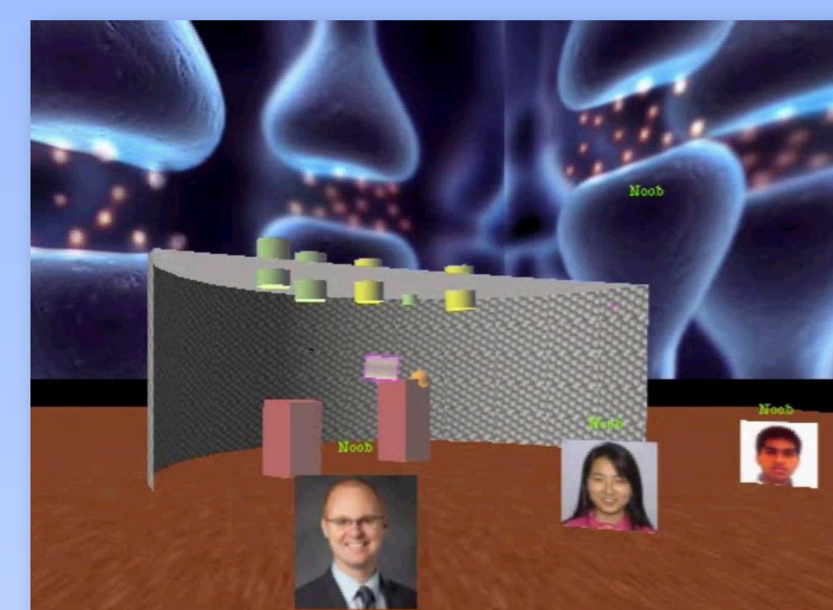
2. Methods

Working in teams of four, students spend 45 minutes constructing a summary figure that visually communicates the principal findings of a given research article. Using either Google Documents Drawing (2D) or Open Cobalt (3D), members of each team simultaneously edit the same summary figure and are then given 5 minutes to use that figure to present the research findings to the rest of the class.

Each of these presentations is immediately followed by an objective assessment of concept understanding and a subjective Student Assessment of Learning Gains survey. The objective assessment is a short answer question requiring higher-order application of course concepts. The subjective assessment asks students to report on their progress towards achieving both lower-order (*knowledge, comprehension*) and higher-order (*analyzing, hypothesizing, designing experiments and articulating concepts*) learning objectives. Exercises are administered at the conclusion of the instructional week with each program being used for 3 consecutive exercises. Students also completed an Index of Learning Styles survey to assess learning preference along four dimensions (active / reflective; sensing / intuitive; visual / verbal; and global / sequential). All surveys are administered on a computer and coded to protect student identity.

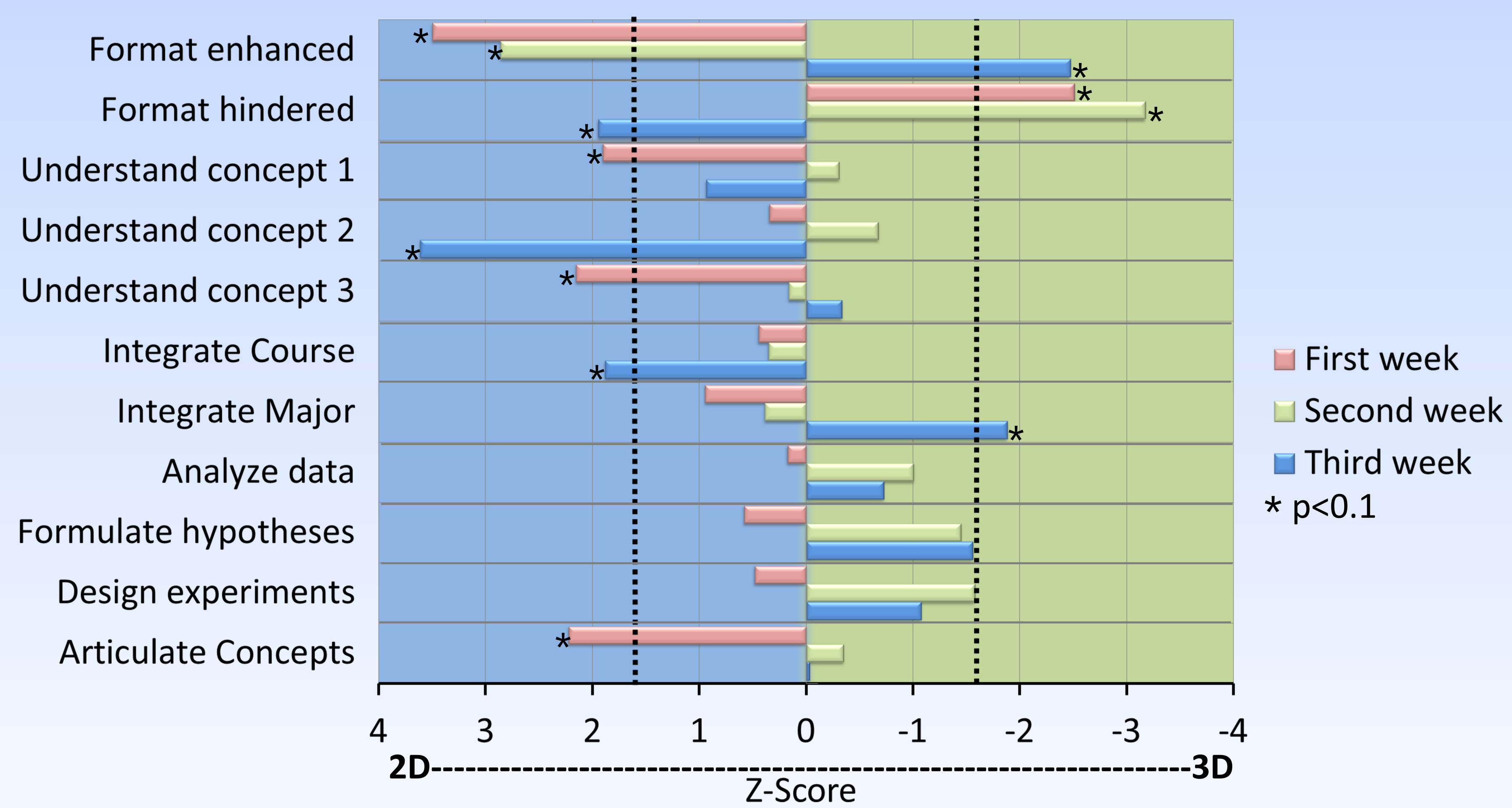




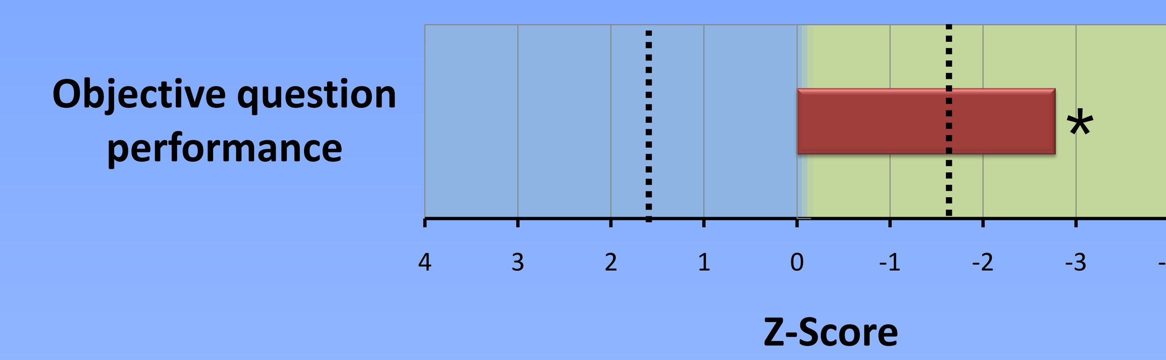


3. Results

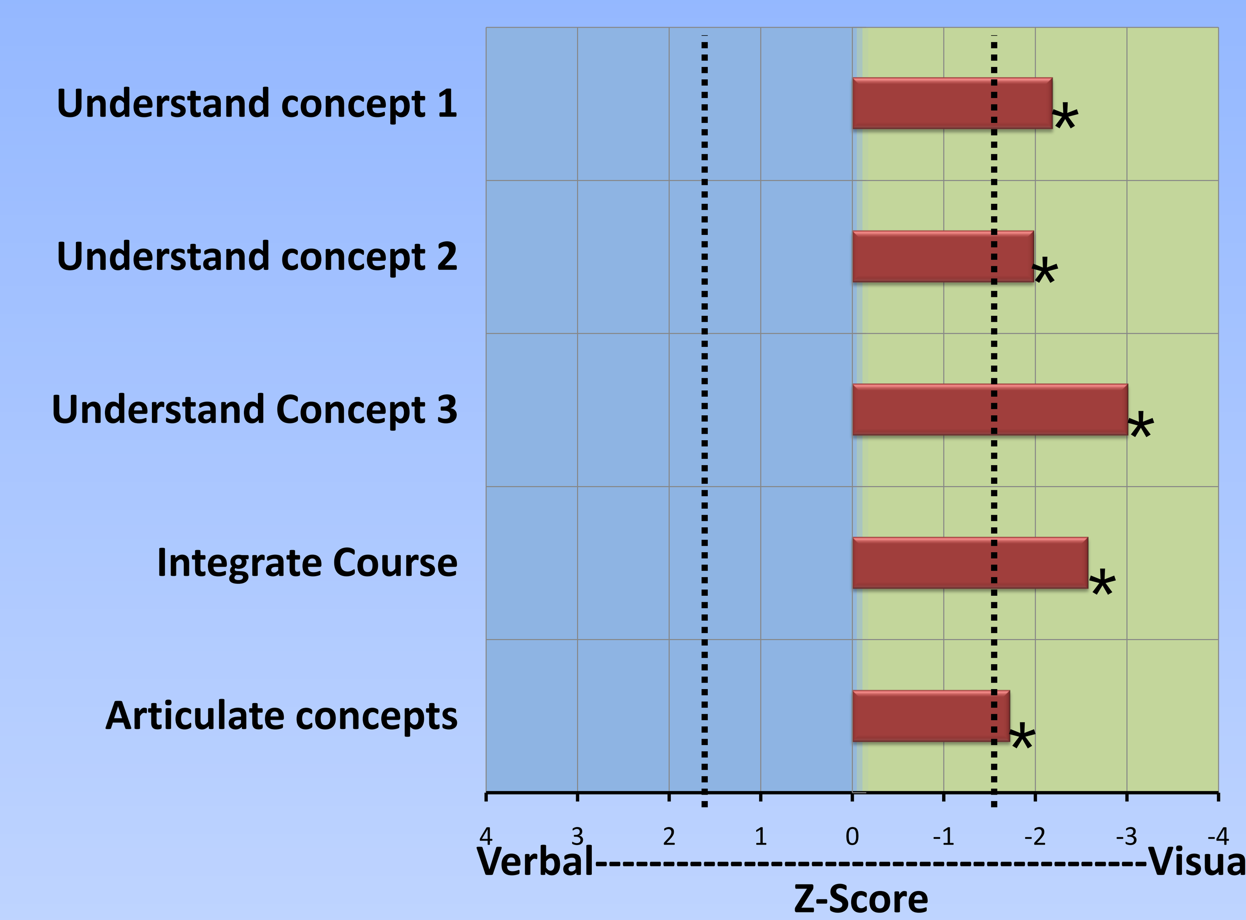
2D Google Docs vs 3D Open Cobalt



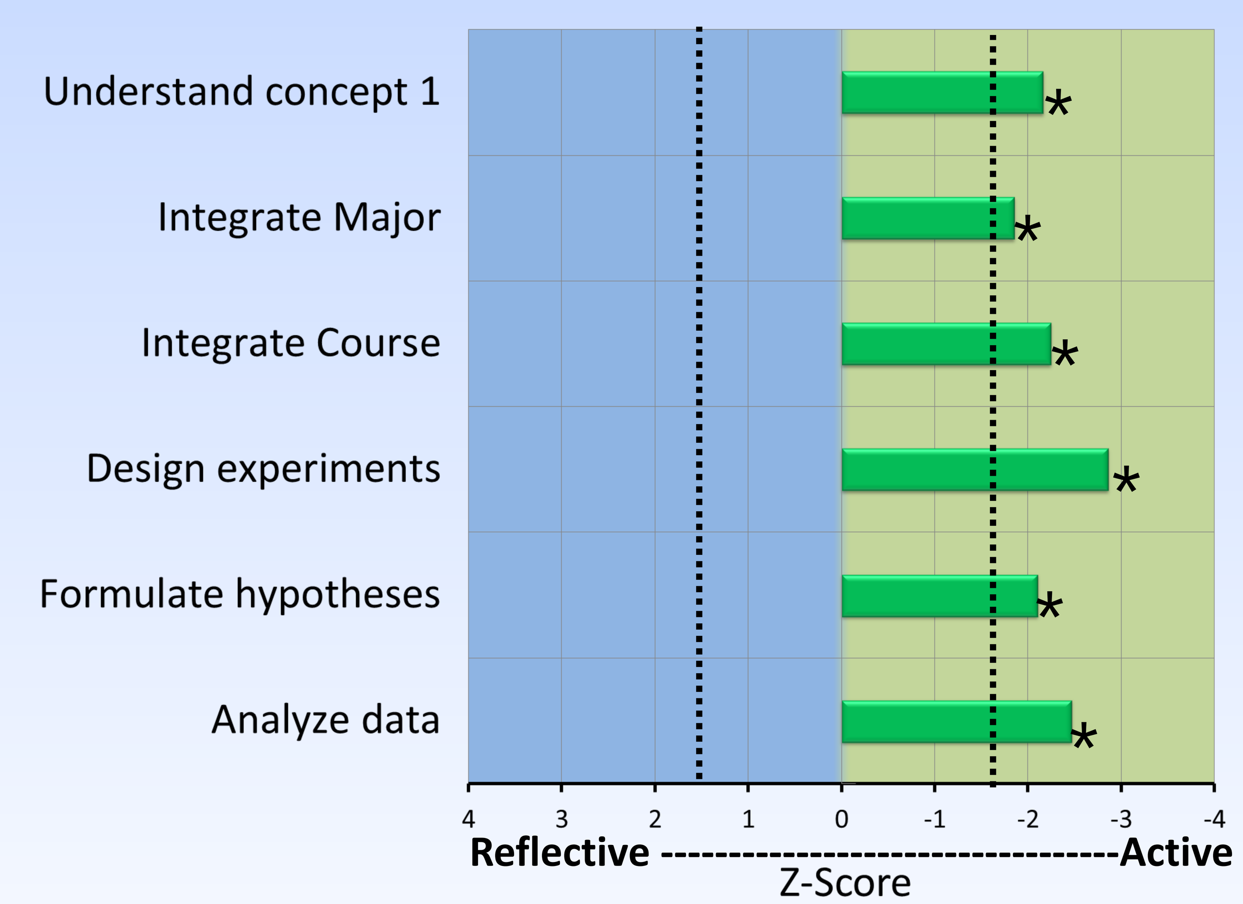
2D Google Docs vs 3D Open Cobalt



3D: Verbal Learners vs Visual Learners



2D: Reflective Learners vs Active Learners



4. Conclusions

- Student attitudes toward the 2 software packages change with experience. By the third week Cobalt (3D) enhances learning.
- Students score higher on an objective test question following 3D visualization.
- Active students perceive greater learning than reflective students following 2D visualization.
- Visual students perceive greater learning than verbal students following 3D visualization.