The Effectiveness of an Authentic Research Experience in High School Astronomy Education

Elin Deeb[1], Luisa M Rebull[2], David V Black[3], John C Gibbs[4], Estefania Larsen[5]

[1]Bear Creek High School (Lakewood, CO), [2]Caltech (Pasadena, CA), [3]Walden School of Liberal Arts (Provo, UT), [4]Glencoe High School (Hillsboro, OR), [5]Millard South High School (Omaha, NE)

ABSTRACT

For high school students to make use of authentic data in a school astronomy setting, they previously needed access to large telescopes with expensive equipment and difficult-to-use software. This has improved as online astronomical data archives have become available; however, difficulties remain, including searching and downloading the data and translating it into formats that high school students can readily analyze. To address these issues, the NASA/IPAC Teacher Archive Research Program (NITARP) selects teams consisting of teacher and students from several schools. Each year, new teams of educators attend an introductory workshop at the AAS where they learn more about NITARP and tentatively select the research project that will use the archived data. Throughout the spring, educators engage in weekly teleconferences, write proposals, and begin working with their students. The teams meet at Caltech in the summer to learn how to access and analyze the IPAC data and continue to work throughout the fall. Finally they showcase their findings at the following AAS meeting. Through this intensive experience, participants learn how to search, download, translate, and analyze authentic astronomical data. They learn the nature of scientific communication through developing a professional poster and presenting it along with practicing astronomers at the AAS conference. In order to measure how successful the 2014 NITARP summer visit was in teaching the participating high school students the terminology and processes necessary to analyze IPAC data, students were asked to create concept maps showing the main and subsidiary ideas and concepts related to their research. They then synthesized their group webs into a master web. When additional terms and concepts were presented, the students were able to readily integrate them into the master web, showing that they understood the relationship of ideas, concepts, and processes needed for their research. Our companion poster, Gibbs et al., presents the scientific aspects of this project. This research was made possible through the NASA/IPAC Teacher Archive Research Program (NITARP) and was funded by the NASA Astrophysics Data Program.

CONCEPT MAPPING BACKGROUND

Concept maps are graphical representations which allow students to engage in higher order thinking through visually organizing the relationships between vocabulary and concepts (Novak & Musonda 1991). Concept maps can be used in a variety of ways—as a unit study guide, as a tool to access prior knowledge, or to assess student growth and understanding following a lesson or unit. Research shows that student performance on summative assessments significantly improves when concept maps are frequently referenced and used to generate group discussion (BouJaoude, S. & Attieh, M. 2008).

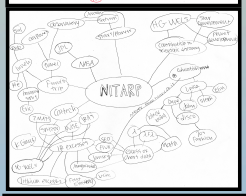
APPROACH

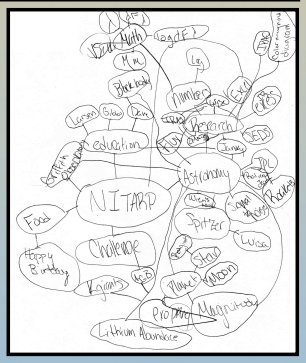
- During the July summer visit at Caltech, student participants brainstormed a starting list of terms and concepts which they then incorporated into concept maps in pairs.
- Through group discussion and comparison, additional terms were added, and a new, large group concept map was developed.
- In November, both students who did and did not attend the conference were again asked to create concept maps.

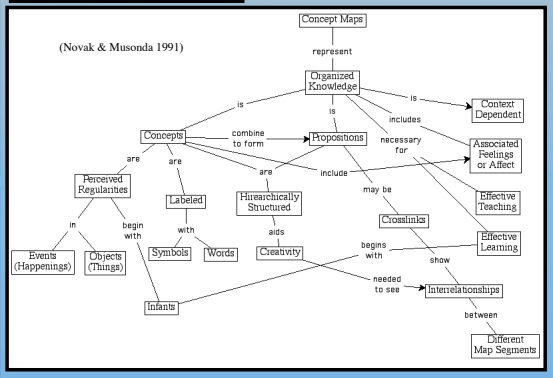
Concluding Remarks

- Concept maps created by students who attended the summer visit include more branches.
- Maps made by students who attended the conference show similarities in connections made.
- When students were reminded of additional concepts or terms, they easily integrated them into their concept maps.
- Concept maps that were made by students who did NOT attend the summer visit were simpler, broader in scope, and included terms irrelevant to the project (e.g. black hole).

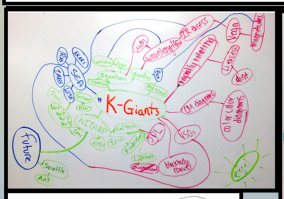
CONCEPT MAPS FROM SUMMER VISIT



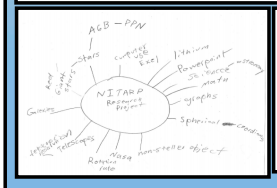




NOVEMBER CONCEPT MAPS FROM STUDENTS WHO ATTENDED THE SUMMER VISIT



NOVEMBER CONCEPT MAPS FROM STUDENTS WHO DID NOT ATTEND THE SUMMER VISIT



RESOURCES

Novak, J. D. & Musonda, D. 1991, American Educational Research Journal, 28(1), 117-153.
BouJaude, S. & Attieh, M. 2008, EJMSTE, 4, 233-246.

Please visit our companion poster
Gibbs, et al.: Searching for IR Excesses around Li-Rich and Rapidly Rotating K Giants Using WISE