30. Navigation

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Rationale and Motivation

Physics and geology faculty at Northern Illinois University (NIU) began to explore possible ways to run joint interdisciplinary workshops in the second year of our participation because (1) Rockford has only four high schools, and also only four physics teachers; (2) earth science is offered only at the middle school level; (3) one of the initiative goals was interdisciplinary curricular, and (4) we viewed the initiative as an excellent opportunity to bridge the gap between middle and high school and the university. The first joint workshop covered basic astronomy and planetary geology. The multidisciplinary approach worked well, and so it was decided to include mathematics and change the emphasis from astronomy to navigation, a field that could incorporate all three disciplines. Involvement in teacher certification and undergraduate general education had made us aware of the weaknesses of incoming freshman in mathematics, English, and science. Our work with the Rockford teachers helped us identify potential sources of those weaknesses. One of us, for example, was quite surprised during a classroom visit to find the level of material being presented to eighth graders regarding plate tectonics. Perusal of a ninth-grade astronomy exam revealed a much greater level of desired achievement than the teachers were aware of. Many of the questions and concepts were similar to those covered in undergraduate general education courses. The problem, therefore, was not in the K-12 curriculum itself but in a "use it or lose it" sense. That is, even though students have been exposed to the appropriate material, they lose their mastery through lack of using it. The eighth grader who was well versed in tectonics will have forgotten much of the information five years later in college. The problem is even more serious in mathematics and English.

Workshop

The multidisciplinary approach that we employed for the workshop is good for addressing the problem of lost mastery. If we could exercise a student's knowledge in different areas, we could strengthen it and even expand it. The daylong workshop included lecture, question-and-answer, and activity sessions. We covered the history of navigation techniques, mathematical principles of navigation, astronomical navigation, historical development of the zodiac, and planetary spatial relationships.

We devoted the morning session to mathematical principles of navigation and cartography, complementing a lecture with group exercises using mathematics to solve problems. The three forms of geometry were discussed, with emphasis on spherical geometry. The afternoon session started with a question-and-answer period, followed by a demonstration of the origin of the zodiacal constellations. We used cards with the constellations, a globe, and an overhead projector as a light source to demonstrate the position of Earth and sun during various

times of the year, relative to the 12 zodiac signs. We also took this opportunity to demonstrate how precession of the Earth's spin axis has changed the timing of the zodiac in recent millennia. We then divided participants for the final two activities – the mobile planetarium (SkyLab) and the Web-based Animated Virtual Planetarium (AVP) simulations. The SkyLab is an inflatable dome, approximately 10 feet in diameter, with a star projector inside. Modules allow for different demonstrations of star positions throughout the year and over long periods of time. It is inflatable, mobile, and can be loaned to individual schools.

The AVP is a series of Web-based, interactive planetary and astronomical simulations developed by one of us for use in a general education course. These can be found at jove.geol.niu.edu/faculty/stoddard/planetarium.html. Among the simulations, "The World's Horizon" can display the sky at any point in time from any point on the Earth's surface. By changing time and viewing location, the user can see how the star patterns change and how they can be used as a navigational aid. Teachers were instructed in its use and were invited to explore other simulations (cometary orbits, a comparison of the Ptolemaic, Copernican, and Tychoan models). In addition, we introduced participants to a Web page mounted for this workshop that includes many resources for middle and high school teachers.

Assessment

We asked each participant to complete a generic workshop evaluation. The results are summarized in Table 1.

Table 30.1 Evaluation Results Summary

	Strongly Agree	Somewhat Agree	No Opinion	Somewhat Disagree	Strongly Disagree
Increased Knowledge & Skills	10	1 (a.m.) 2 (p.m.)	0	2	1 (a.m.) 0 (p.m.)
Relevant to Standards	8	3 (a.m.) 4 (p.m.)	1	1	1 (a.m.) 0 (p.m.)
Experienced Presenters	13	1 (a.m.) 0 (p.m.)	0	0	1 (am) 0 (p.m.)
Material Organized	9	3 (a.m.) 5 (p.m.)	0	0	2 (a.m.) 0 (p.m.)
Ample Discussion, Activities	8	2 (a.m.) 3 (p.m.)	0	0	1 (a.m.) 0 (p.m.)

The strongest points of the workshop, based on teacher comments, were the mobile planetarium, with the website a respectable second. One of the few improvement suggestions was to deliver the mathematics portion of the workshop at a lower level more appropriate to middle and high school students. Most participants felt the workshop increased their knowledge, one of our primary goals, and that it related to the state and NCATE standards.

Conclusions and Recommendations

The school teachers gained in concepts, activities, and materials that could be directly used in the classroom, while the university faculty gained an understanding of the problems and concerns of the teachers, and both felt that they developed relationships that may continue beyond the initiative. Further, teachers and faculty together agreed that their respective teaching approaches would become more interdisciplinary and integrated in nature. A secondary benefit is that by improving the level of understanding among the teachers, we may see improved freshman classes in the future. Upon reflection, we also found that more time for informal discussions between the different faculty and teachers would have been of great benefit.