Got Scope? The Benefits of Visual Telescopic Observing in the College Classroom

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Abstract
The author discusses pedagogical successes achieved in a course based on visual telescopic observation for college students in all majors.

1. Introduction
Numerous papers in the astronomy education literature have debated the worth of including visual telescopic observations in college-level courses (e.g. Kim 1990; Maraziti 1996; Mills 1980; Waller 2004; Walsh 1994). The arguments against the pedagogical value of such experiences for non-science majors include the unpredictable nature of weather, the frustration experienced by some students when the image at the eyepiece fails to live up to unrealistic expectations (largely due to Hubble Space Telescope images widely disseminated in the media), the ever-increasing problem of light pollution, and problems of not having sufficient telescopes to accommodate a large number of students. In the case of astronomy majors and minors, there is an additional concern that visual astronomy is not “realistic” – that “real” astronomers don’t actually look through telescopes as part of their job.

On the other hand, it has been argued that what students most want from their college astronomy courses is to observe the real sky, to experience what is often called the “eyeball on glass” nature of visual telescopic astronomy. Such experiences can excite students and make an impact that lasts far beyond the end of a general education course. Hamilton (1990) and Percy (1996) have additionally argued that including active-learning experiences in the astronomy laboratory, such as those naturally offered through observational astronomy, is especially important in the training of pre-service teachers. This paper will explore the author’s experiences introducing science and non-science majors as well as pre-service teachers from a number of disciplines to the immediate joys and unlimited potential of visual telescopic viewing in the course ESCI 278 Observational Astronomy.

2. The Course
ESCI (Earth Science) 278, Observational Astronomy, is a four-credit course offered nearly every Fall semester that can be used as part of the astronomy minor, earth science or science education major, or by non-science majors to fulfill the science laboratory requirement for general education. The course has been running for over twenty years, and until approximately five years ago had a prerequisite of any Astro 101 course. When it was determined that students who had been given permission to enroll in the course without the prerequisite did as well as those who had taken the required prior course, the prerequisite was dropped. The course is structured around two 50-minute daytime sessions and two 2-hour nighttime sessions per week. Students are trained in operating a wide variety of astronomical instruments, including mounted and handheld binoculars, equatorially mounted reflectors and refractors, Newt-Dobs, and a Schmidt-Cassegrain telescope with a solar filter. The largest telescope is the 16 inch Cassegrain in the rooftop observatory. The other instruments are used on a special fenced-in rooftop platform. All instruments are operated manually (objects are found via starhopping) and only the observatory telescope has a tracking motor. Therefore students become adept at locating and manually tracking objects. While the course stresses telescope operation and the night sky, students also learn about why the objects they are viewing appear the way they do in the telescope (e.g. observable features of the planets, binary stars, star clusters, etc.).

Due to the hands-on nature of the course, enrollment is capped at 16. The audience comes from an extremely varied background in terms of prior experience with visual observing. Some students have never looked through a telescope before in their lives while others have telescopes of their own at home. On a given night a selection of four or five
different instruments are used, with students rotating through the instruments to observe a variety of objects and gain experience working with each instrument. While the team approach helps to support the novice observers, by the end of the semester it is understood that each student will be capable of finding objects on their own with each instrument. While there is no pattern to the ratio of science majors to non-science majors enrolled, the audience is generally sophomores through seniors and, interestingly, there is often gender parity in the course (something that is generally rare in physical science courses). Indeed, in four of the past five classes women out-numbered men. Given the gender inequality in both amateur and professional astronomical circles this result is encouraging.

3. Service-Learning in the Observatory

While paper and pencil testing of student knowledge is used within the course (including exams and a careful scrutiny of log books), performance-based assessment is key to ascertaining whether or not students have mastered the basics of visual telescoping observing. Beginning in 2004, a service-learning capstone project was integrated into the course, a series of public observing sessions that are planned, advertised, and conducted by the students. This capstone allowed students in non-science majors to draw upon their strengths, such as the writing of press releases or the graphic design of posters to advertise the event around campus (Larsen 2011). The sessions are planned for four consecutive nights at the end of the semester (early December), with the understanding that, on average, only two of the four planned nights would actually have clear skies.

Service-learning differs from more general community engagement or volunteerism in that the students are drawing upon, and demonstrating their mastery of, the content that is central to the course (Enos and Troppe 1996). Student course surveys demonstrate that the activity is very popular with the students enrolled in the course, and feedback from the community and campus members who attend the event each year also demonstrates that it is highly appreciated. For many it is their first experience with our long-standing tradition of free public observing nights (and planetarium shows) at CCSU. The high percentage of female students in the course has not gone unnoticed by the public in attendance, which perennially includes children from area schools and entire families. Many teachers and parents have commented on the strong signal sent to their daughters and female students by actually seeing female role models operating telescopes with poise, confidence, and proficiency.

While the course and its capstone activity are, by themselves, highly successful in achieving their stated ends, is there a lasting impact upon the students who complete it? Does a semester of learning the basics of visual telescopic observing ultimately make a difference in these students’ lives? The remainder of this paper discusses concrete examples of how the answer to this question is an unqualified yes.

4. Examples of Lasting Impact on Students

4.1 Paying it Forward on Campus(es)

One of the most important “perks” of successfully completing ESCI 278 is that students are qualified to borrow the key to the rooftop observatory for their personal use. But do students actually do so? The answer is, of course, yes. But what is more important is that students do not just use the observatory for their own personal enjoyment, but bring other students with them. A male art major who took the course as a first semester freshman brought fellow students to the observatory on his own time once a semester for several years. A female astronomy minor and resident assistant in the freshman dormitory hosted observing sessions for her residents several times during the year. The events became so popular that the residents began requesting additional sessions on residence life surveys.

Education majors who completed the course often bring their own students to our campus to attend planetarium shows and look through our telescopes as a direct result of having completed this course. In addition, a number of the education majors who have passed through this class have reported to me that they successfully rescued telescopes they found in their own classrooms (upon becoming fulltime teachers themselves). These instruments had been mothballed by previous teachers who did not know how to use them. The result has been hundreds (if not thousands) of school children who have been able to view the night sky for themselves thanks to the efforts of teachers who learned that visual telescopic observing is a valuable skill for exciting the public about astronomy in particular and science in general.

4.2 Changing Minds/Changing Majors

While the course is open to both science and non-science majors, admittedly it does attract more science (and mathematics) majors. A number of students who have taken this course not only take addi-
tional astronomy courses based on their experience in
ESCI 278, but some have actually changed their ma-

jor to earth science and/or their minor to astronomy.
One male student in particular changed from a busi-

ness major to an earth science major and went on to
complete a masters degree in science education. Oth-

er students have completed advanced degrees in as-

tronomy. While “converting” people to make astron-

omy their vocation is certainly not the intent of the
course, it is gratifying that it has been a seminal ex-

perience in the lives of more than a few students.

4.3 Becoming an Amateur Astronomer

A more realistic goal is to motivate students to
take on astronomy as a free-choice activity, by be-

coming an amateur astronomer. A number of students
who have completed this course have purchased their

own telescopes, and two young ladies are currently
grinding their own 8-inch telescope mirrors through
the Springfield (VT) Telescope Makers. A number of
students have attended the Stellafane Convention as a
result of this class and become involved in local ama-
teur astronomy clubs.

4.4 Research Projects

Finally, an important outgrowth of the course has
been a desire by a number of students to keep learn-
ing about visual telescopic observing through doing
independent study projects or even becoming in-
volved in ongoing observing projects. One female
student has been submitting sunspot observations
through the AAVSO for the past year, and she and
another female student (both earth science majors)
have worked with me on a research project to identify
potential Cepheids and BY Draconis stars from
ASAS light curve data. Both students have presented
their projects at conferences, an important step in
building up their portfolios for graduate school.

It is therefore seen that students have been im-
pacted in meaningful and long-term ways through
their experience with visual telescopic observing in
this college course. The final section of the paper
focuses on what the students themselves believe to be
the most important lessons taken from this course.

5. Student Voices

An important part of the service-learning cur-
riculum is to have students reflect upon their com-
munity engagement experience and relate it to their
own learning. Such reflections provide valuable tes-
timonials to the power the experience of visual tele-
scopic observing (and sharing that experience) can
have on an individual. In this section of the paper a
number of students who have taken the course over
the past two years have their chance to explain what
the experience meant to them.

One young woman, an astronomy minor, noted
in her reflection piece:

One memorable moment was when a younger
boy of about nine came into the observatory and
was very excited to see Jupiter. He started ex-
plaining to us that he had just learned about Jupi-
ter in school and was so excited to see it for him-
self in person…. When he looked into the eye-

piece his face lit up and the smile on his face was
so large it stretched from ear to ear. This boy was
so excited to see Jupiter and four of its moons he
could barely contain himself. He started asking
me all sorts of questions as to what the bands on
Jupiter were and I was impressed when he knew
that he was looking at the Galilean moons. He
stayed staring at Jupiter for at least five minutes.
He was absolutely entranced by Jupiter and
loved every minute of it.

A young man who was a science education major
admitted

At first I was a bit nervous. Even though my ma-

jor is Education, I had never really gotten in
front of anyone to teach them something. The

nerves quickly went by the wayside as people
began to approach me. I knew my stuff and there
was nothing to be worried about…. I had a blast.

A female science education major noted

Pictures of planets, galaxies and clusters are
available in books or online but it’s so much
more powerful to see them for yourself…. The
Andromeda Galaxy is just a faint smudge of light
through a telescope but knowing how immense a
galaxy is and being able to see just the faintest
bit is pretty exciting for children and adults. It’s
more powerful than a photograph…. The image
through a telescope may be smaller with less
color, but knowing that you are looking at the re-
al object out in space is like proof.

She further added

I know my father has decided he must have a
pair of more powerful binoculars than the ones
he already has, and my mother has purchased
them for him as a gift. A little observation of the
night sky can spark some curiosity in people to
take a closer look at what is around, or in this case above, them.

But it is not just the science and science education majors who have powerful experiences at the telescope. A young man who was a graphic design major explained:

One group of CCSU students in particular made me really happy when they said they wanted to take the ESCI class next semester because of what we did those nights. Another interaction I experienced was when I went to get lunch in the student center and the person at the grill said that she went to the event and will probably go on another night if she doesn’t have to work…. I am extremely glad I took this ESCI class so I could be a part of this event. Not only was I able to make a cool design poster for the event, but also I was able to connect with my classmates and the community. This will definitely be one of the best memories that I will have from college.

Finally, a young woman who was an art education major illustrates the profound impact time at the eyepiece sharing the night sky with the general public can have:

Experiencing the excitement of people realizing the significance of what they’re looking at was one of my favorite parts. Being able to feed into that excitement and be present for many occurrences of it really opened my eyes to the joys of being a teacher. Even though my concentration is in art, this experience solidified my decision to be a teacher that much more…. Being able to use the knowledge I have gained over the whole semester was a really empowering experience, especially in the context of being able to educate the public. From setting up the telescopes on our own, to finding the objects, to explaining our objects, this overall class experience is one to remember and will stick with me as I continue with my career.

6. Conclusion

A science education major summed it up best, when he noted in his reflection:

The students became the masters, and it didn’t matter what major students were. We had students of all majors in our class and at the end of it we all came out of it with a much better understanding of the night’s sky. With this capstone I really think we not only did the public a service by putting on these observations, but they served us as well.

This student later went on to work on three of the Astronomical League’s observing programs (Dark Sky Advocate, Urban Observing Program, and Lunar Program) as an independent study project to examine how these programs could be used as a student enrichment program in high schools, and is currently under consideration for a high school teaching job in which he will be teaching astronomy, meteorology, and environmental science. His future students will certainly benefit from his experiences at the eyepiece. Visual Telescopic Observing may have its challenges, but the rewards far exceed any momentary inconveniences.

7. Acknowledgements

The author wishes to thank the students in her ESCI 278 course from the past twenty-plus years. It has been a joy to share the eyepiece with them.

8. References


