PHYSICS 101: The Solar System

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Project Statement:

During the course of the summer session, each student or a group of students (two at the most) were responsible for preparing an extended paper on a specific astronomical issue that was assigned by the professor. Before being the research on this topic the (10) students were given an information literacy lecture by Katie S. Duke, consulting librarian on this project. As emphasized in the initial grant proposal, the students will be required to do research on the literature of their topic and critically think about what sources will be useful to them and will add credibility to their paper.

This assignment clearly incorporates the following ACRL Standards and as a result the students will be able to:

Standard One: The information literate student determines the nature and extent of the information needed.
Performance Indicator

1. The information literate student defines and articulates the need for information

Outcomes:

a. Confers with instructors and participates in class discussions, peer workgroups, and electronic discussions to identify a research topic, or other information need
b. Develops a thesis statement and formulates questions based on the information need
c. Explores general information sources to increase familiarity with the topic
d. Defines or modifies the information need to achieve a manageable focus
e. Identifies key concepts and terms that describe the information need
f. Recognizes that existing information can be combined with original thought, experimentation, and/or analysis to produce new information

Performance Indicator

2. The information literate student identifies a variety of types and formats of potential sources for information.

Outcomes:

a. the purpose and audience of potential resources (e.g., popular vs. scholarly, current vs. historical)
b. Differentiates between primary and secondary sources, recognizing how their use and importance vary with each discipline

Standard Two: The information literate student accesses needed information effectively and efficiently
Performance Indicator:

1. The information literate student constructs and implements effectively-designed search strategies. Early indigenous groups

Outcomes:

a. Develops a research plan appropriate to the investigative method
b. Identifies keywords, synonyms and related terms for the information needed
c. Selects controlled vocabulary specific to the discipline or information retrieval source
d. Constructs a search strategy using appropriate commands for the information retrieval system selected (e.g., Boolean operators, truncation, and proximity for search engines; internal organizers such as indexes for books)
e. Implements the search strategy in various information retrieval systems using different user interfaces and search engines, with different command languages, protocols, and search parameters

Before the students begin the research on their assigned Astronomy research they worked on two Information Literacy Exercises that when finished was turned in for evaluation using the ACRL Standards.

Assessment of the Library Assignment:

a. Identifies key concepts and terms that describe the information need.
   83% of the students could identify keywords and construct a search strategy using Boolean Operators that would help them retrieve the book if they could not remember either the author or the title.

b. Implements the search strategy in various information retrieval systems using different user interfaces and search engines, with different command languages, protocols, and search parameters.
   75% of the students developed a plan to implement a search strategy to retrieve the requested information.
   58% carried out the developed search to databases that were not suggested by the instructors.
   30% of the students failed the course (due to fear of mathematics and math application in astronomy)
   20% of the students received a final grade A (excellent work on both paper assignment and class exams)

Research Paper Assessment

Based both on regular and library class instruction, each student was assigned a separate topic out of the following pool:

i. The Magnetic Field of planet Jupiter
ii. Halley's Comet: a Comet's Anatomy
iii. Sunspots
iv. Saturn Ring System
v. Origin of the Moon
vi. The Cassini Mission
vii. The Pluto system
viii. Water on Mars
ix. Water in the outer solar system
x. The Oort Cloud

The students were allowed to work in teams, but they were supposed to prepare their own paper, based on the topic selected from the list above. This method seems to have a positive impact to the students' attitude toward the course as a whole

- Each written report was graded according to (a) content (b) form and (c) style
- 70% of the grade was based on content. This was the instructor's choice and it was not communicated to the students
- Form and style shared 30% of the grade: students were allowed to pick the writing style they were more used to (in reality, APA style was selected by *all* of them). Form required in this class meant (and was thoroughly explained in class, on the board) the existence of specific chapters/paragraphs with titles and subtitles. Each report/paper had to include (a) a concise abstract/summary, with significant results (b) an introduction where background information was supposed to inform the reader about the current project under study (c) a main portion of the paper with a specific title (e.g. *Experimental evidence of water marks on planet Mars*) (d) a conclusion/summary of the report and (e) a reference list. The latter was supposed to include a series of *mainly* scholarly publications, which were picked by the student, briefly read and reported upon. Scholarly was defined a publication (in this specific class, and for its needs only) that was including (1) rigorous scientific discussions of specific projects and (2) one that was discussing in modern scientific terms the specific phenomenon.
- Plagiarism was an issue: there was a strong tendency for "copy and paste". Given the abundance of information on astronomical topics, it was noticed that several students were ready to pass exact statements to their papers. A special intervention by the instructor was successful in stopping the phenomenon, although the class knew that plagiarism means *instant* failure of the course.

The students were also responsible (and were graded upon) for realizing the following aspects of their research paper:

a. Need for further research
b. Design a search strategy (ensured via work in situ, at the library with the help of the involved librarian)
c. Isolate in an *effective* way the collected information
d. Assess search results through scholarly papers and books, and
e. Develop a final report as a paper or "thesis" regarding conclusions of the search

- A major weakness in the process is the fact that many students rely heavily on the adopted course text. This happens regularly, especially at the end of the term, when time is running out due to fast approaching final exams. We have concluded that this is seen by many students as a non-threatening approach (as far as the grade is concerned) for the simple reason that the textbook cannot simply be by-passed. Several students *lost point*s when they adopted this approach.

2. **Solid Gains**

Highest learning among non-science majors occurs when

a. A chance is given to the individual student to perform his or her own research on modern astronomical topics
b. Team work is involved, especially in data collection
c. Absence of memorization is actively in use
d. Triggered interest

Parts (a) and (b) were particularly successful. The students learnt the meaning of physical law, with its most celebrated version: Kepler's laws of planetary motion. Individual and teamwork were combined with success. Part (c) above works always to the benefit of the student(s). The instructor introduces the students to the idea of the physical law, in connection with the modern science, especially from the point of modern physics and astronomy (this was a physics 101 course after all). Item (d) worked fine in several cases, particularly when the instructor indicated ignorance of specific topics (e.g. *most recent results from the Cassini mission*, etc). Given this, actual class teaching worked to the benefit of the students: introduction of the physical law and subsequent immediate use of theory in realistic calculations, worked to a satisfactory degree: the students had to use pocket calculators for many realistic calculations (e.g. “back of the envelope calculations” of escape velocities from planetary surfaces).

3. Conclusion:

Overall, we believe that the non-science students were a given a fair chance to learn many aspects of the solar system as seen today. They had to pass four written tests and to prepare a research topic. Class teaching, combined with “live” *in situ* literature search guidance, **worked best**, especially in **teamwork**. Inevitably, there were cases of students with disappointing results in the exams, which we attribute to the old and very much alive problem of **fear of mathematics**. Unfortunately, the number of students involved in this class was rather small (only seven out of ten students), and thus no significant statistics can be extracted at the present moment. One of us is currently collecting data from the last ten years, in an effort to quantify the phenomenon of *fear of mathematics* in science course teaching, in today’s university in general and especially here at the University of Scranton.