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The Effectiveness of Model Rocketry to Teach Science and Quantitative Content to Students in a Non-Science Majors Course at the College Level: An Example from a Planetary Geology Course

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Abstract

Engaging non-science majors in a college-level science course can prove challenging. In turn, this can make it difficult to effectively teach science and math content. However, topics related to planetary exploration have a unique way of capturing one's imagination and may serve to robustly engage non-science majors. In this contribution, I 1) describe a model rocketry lab module, I have created and implemented into an introductory-level planetary geology course and 2) quantify student learning gains as a result of this module. This module builds on model rocketry lesson plans for science and math coursework at the K-12 level (e.g., [1] [2]) and involves students working in groups to 1) design and build model rockets to carry out a theoretical mission that addresses a science question the students have developed, 2) launch their rockets and collect related data, 3) synthesize and evaluate their data, and 4) report their results in both oral and written forms. The tasks of building and launching the model rocket serve as a vehicle that allows students to employ the scientific process while learning about planetary mission design and applying geologic and quantitative skills useful to answering a science-related question. Quantification of student learning gains shows that through this lab module, students significantly improved their quantitative and scientific reasoning skills. Results from student questionnaires showed a significant increase in student interest and confidence in addressing scientific questions as well as an understanding of how planetary missions are designed and conducted.

Keywords

Introductory Geology, Non-Science Major, Planetary Geology, Model Rocketry

1. Introduction

General education curricula at many colleges and universities require students take at least one physical or natural science course. Non-science majors, however, may have high anxiety about taking science-related courses [3] [4] [5] [6], which can subsequently impede their learning [6] and openness to course content [7] [8]. This can make it challenging for science instructors to teach and connect with non-science majors in their courses [9], which, in turn, can help perpetuate anxiety and, thus, disinterest in science [10] [11] [12]. Overcoming these anxieties is therefore critical for science faculty to successfully reach non-science majors at the college level (e.g., [13] [14] [15]).

Model rocketry, a hobby that extends from the space race of the 1960s [16], represents one approach that has been widely and successfully implemented at the K-12 level to capture student interest and teach critical science concepts (e.g., [1] [2] [17]-[25]; for a more complete listing of efforts of model rocketry lesson plans implemented in STEM lesson plans at the K-12 level, see [2]). One reason for its success has been due to its ability to capture peoples' attention in space exploration [16], which, when taken with its hands-on nature [2] [26], has made it a frequent method to teach science and math concepts in the K-12 system (e.g., [1] [2] [24]). In turn, this has had a seemingly positive impact with promoting science literacy in the K-12 system [24].

Model rocketry has been successfully implemented at the college level as well. For example, [27] [28] [29] all describe model rocket based projects in introductory aeronautical engineering coursework as a means of capturing student interest and introducing students to engineering concepts. Through qualitative assessment, these authors found that such projects are critical for sustaining interest in engineering [27] [29] and for developing engineering skills critical for their career [28]. These results are intriguing because they show that an activity implemented in the K-12 system to teach STEM (science, technology, engineering and mathematics) concepts can also be applicable at the college level. However, quantitative assessment of the effectiveness of such modules at the college level to teach STEM concepts is lacking. Despite the plethora of previous work that has described the implementation of model rocketry into the K-12 and college levels, there is no clear demonstration of learning gains that have occurred through these modules. Here I describe a multi-week lab module for an introductory planetary geology course (Geol 203/204 Voyages to the Terrestrial Planets/Lab) at Mercyhurst University in Erie, PA USA that was geared towards non-science majors. Qualitative and quantitative assessments of student learning gains and attitudes with the use of this module illustrate that model rocketry can effectively engage non-science majors while significantly improving their quantitative and science skills. Although the idea presented here of developing a model rocketry lab module is not new, this work does represent the first known quantification of learning gains to be reported on a model rocketry lesson plan.

2. An Overview of Model Rocketry

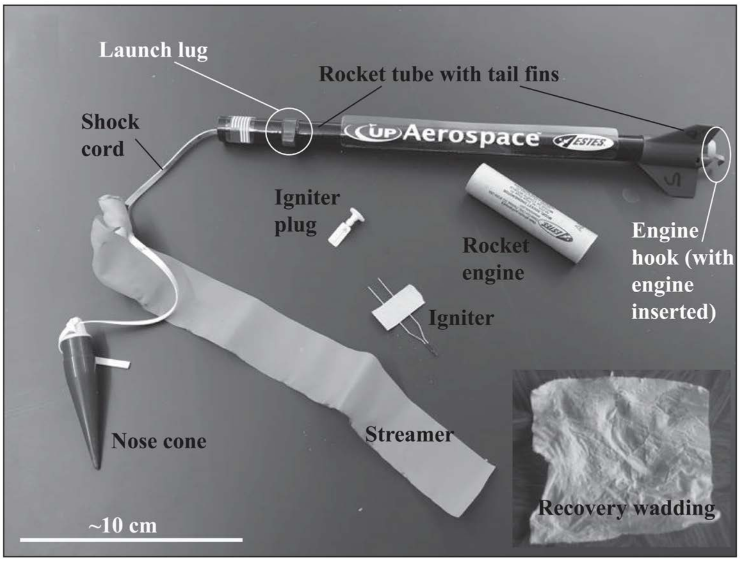
Model rocketry is a hobby that uses a "small" aerodynamic rocket propelled into the air by some source [2] [16]. Rockets can range in size from approximately 20 cm to well over a meter in length [16] and can be assembled from kits or made from scratch. Rockets can be powered by a variety of means including water [30] and a small engine filled with a propellant [16]; in this paper, I focus on rockets that utilize a small engine. In this section I describe the components of a model rocket system, construction of a rocket, and the launching and trajectory sequence of a model rocket.

2.1. Model Rocket Components

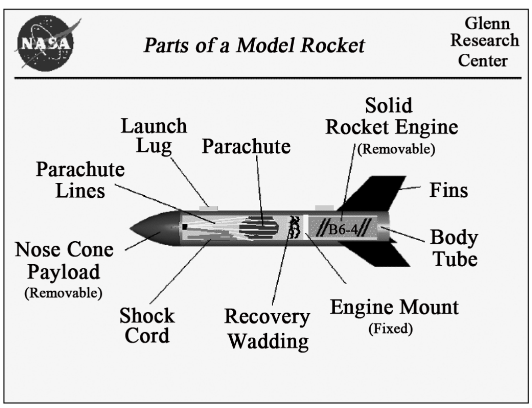
Figure 1 highlights the components of a model rocket system. The model rocket itself consists of (**Figure 1(a)**): 1) a hollow tube with tail fins and two launch lugs; 2) a removable nose cone with an elastic shock cord; 3) an engine, which consists of a propellant that boosts the rocket into sky when ignited; 4) an igniter, which are two pieces of thin wire bound together at one end by a pyrotechnical material as well as an igniter plug; 5) a piece of fireproof recovery wadding; and 6) a recovery system, which may be either a parachute for larger rockets or a bright streamer for smaller rockets.

Figure 1(b) highlights how these components fit together to create the model rocket. Specifically, the nose cone sits on top of the hollow tube; the elastic shock cord is tied to the base of the nose cone with the other end glued inside the hollow tube. The rocket engine is inserted into the base of the hollow tube where it is held in place with a metal hook. The igniter is placed into the base of the engine and is kept in place with the igniter plug. The recovery wadding is placed into the hollow tube above the engine and serves the purpose of protecting the recovery system from the hot engine during flight [16]. The recovery system resides inside the hollow tube until the rocket reaches its apex when it is deployed and helps slow the rocket's descent back to the ground.

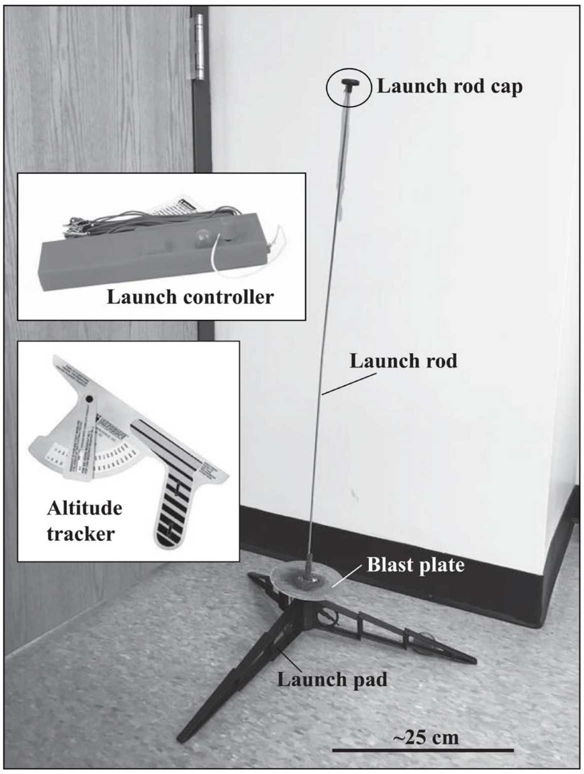
Additional components needed for launching the rocket include the launch pad and launch controller (**Figure 1(c)**). The launch pad is a tripod with a metal blast plate on which the rocket sits. The rocket is attached to a metal launch rod by the launch lugs; the rod extends through the blast plate from the top of the tripod and can be angled so as to help guide the direction of rocket flight (e.g., to account for wind). When not in use, a launch rod cap that contains an orange streamer can placed at the top of the launch rod for safety. The launch controller



(a)



(b)



(c)

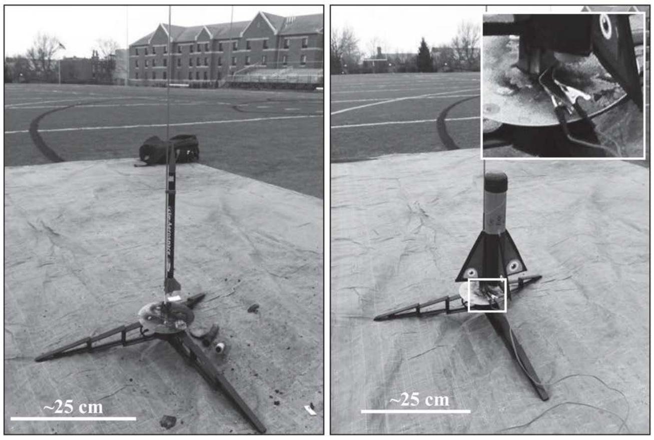
Figure 1. Components of a model rocket. (a) The model rocket tube and pieces that go into it. Inset image highlights the recovery wadding, which a flame resistant sheet of material that is inserted into the bottom of the rocket above the engine; it provides a shield between the hot engine and the recovery system located higher in the rocket. Inset image from: https://www.instructables.com/id/Model-rocket-recovery-wadding/; (b) Diagram illustrating how the components of the model rocket fit together. Image from https://www.grc.nasa.gov/WWW/k-12/VirtualAero/BottleRocket/airplane/rktparts.html; (c) The launch pad and its components. Upper inset is an image of the electrical starter; image from https://www.megahobby.com/products/electron-beam-model-rocket-launch-controller-estes-rockets.html. Lower inset image is Estes altitude tracker that allows for determining the maximum height a rocket attains during its flight; image from https://www.discountrocketry.com/quest-skyscope-altitude-measurer-pack-p-2133.html.

is a battery-powered (two AA batteries are typically required) device that is connected to the igniter by two metal clips. A key connected to the launch controller can be inserted into the controller in order to help initiate launch. An altitude tracker can also be purchased (or even constructed [e.g., 16]) to help track and calculate the height a rocket attains during its flight.

2.2. Model Rocket Launching

Launching a model rocket requires an open space (e.g., an athletic field) that is void of people, infrastructure, and/or vegetation that can be damaged by a rocket or cause damage to a rocket. Once such a location has been identified, the fully assembled rocket (**Figure 1(b)**) is attached to the launch pad (**Figure 2(a)** and **Figure 2(b)**). The battery powered electrical launch controller is then connected to the igniter at the base of the rocket by two metal clips. A key is then inserted into the launch controller, which should turn on the light on the controller. Once the light is on, the ignition button is pressed, which sends an electrical current to the igniter causing the propellant in the engine to burn and propel the rocket up and off of the launch pad. All parts of the rocket and igniter set-up need to be kept dry and batteries should be fresh in order to maximize ignition success.

In an ideal case with a model rocket kit, once the rocket has been ignited and has begun its initial ascent, it will follow a parabolic trajectory (**Figure 3**). The first part of the trajectory is the powered ascent where the engine is burning the propellant it contains. Once the propellant is used up, a delay is activated that produces a tracking smoke and allows the rocket to coast until it reaches its apex. Once the apex is reached, an ejection charge is activated that ejects the nose cone and activates the recovery system [31]. The rocket will then descend back to Earth where it can be recovered and ideally launched again with a new engine.



(a) (b)

Figure 2. Examples of model rockets on a launch pad; both images are from the module described here. (a) An Estes Industries kit rocket; (b) A self-built model rocket. Inset figure highlights the clipping of the electrical starter onto the igniter.

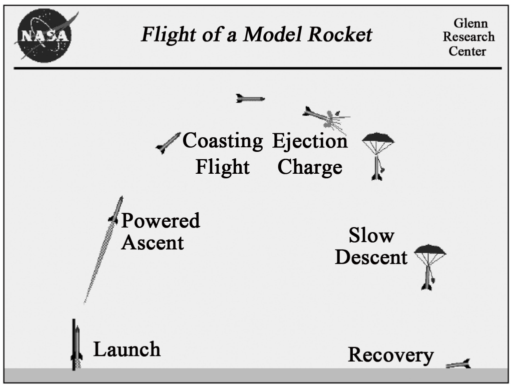


Figure 3. An idealized sequence of the flight path taken by a model rocket from its launch to its eventual touchdown. Image from: https://www.grc.nasa.gov/WWW/k-12/VirtualAero/BottleRocket/airplane/rktflight.html.

2.3. Constructing Model Rockets

All of the components needed for building and launching a model rocket can either be purchased as part of a kit (e.g., [2]) or built from scratch using household items (e.g., [26] [27]). Ready-to-build rocket kits can be purchased online or from most hobby stores and range in size and level of difficulty in building. Multiple companies produce model rocket kits including *Estes Industries* and *Apogee Rockets* being two of the more prominent companies; in the module I describe here, all rockets and components are *Estes Industries* products. For those who are new to model rocketry, I strongly recommend beginner level kits. If using Estes Industries brand rockets, I recommend purchasing educator bulk packs, which contain 12 to 24 beginner level rocket kits including all of the components needed to build a rocket and make it ready for launch. These kits can range from ~$50 to >$100 depending upon the rocket style and may include all components except the launch pad and launch controller, which need to be purchased as a separate item (~$20). Purchasing the educator bulk packs is less expensive than purchasing all of the components separately and serves to simplify the organizing and building of the rockets.

In some cases, the engines may need to be purchased separately from the rocket kit. If so, the recommended engine type for the rocket is listed on the rocket kit box. Engines range in size depending upon its average thrust; smaller rockets [such as those in the educator bulk pack] need engines with a smaller thrust whereas larger rockets need engines with more thrust. Each engine will have a letter-number-letter code (e.g., A8-3) where the letter indicates the engine's total impulse, the first number indicates the average thrust, and second number indicates the time delay between the end of the thrust phase and the initiation of the ejection charge [31]. Letters range from A-D with being the lowest impulse (used for smaller, lighter rockets) and D having the highest impulse (used for larger, heavier rockets). Engines, if purchased separately, cost ~$10 for a pack of two to four; each pack also contains igniters and igniter plugs as well as instructions on how to use the engines and a chart that describes the impulse, thrust, and delay for all engine types.

Building rockets from scratch can be trickier because all of the components need to be independently obtained. Multiple online resources (including numerous YouTube videos) exist that provide tips and steps for useful materials and how to assemble them into a rocket suitable for launch. Similar to kit rockets, an engine and launch pad and igniter are still needed to launch the rocket. However, the same engines and launch pad used with kit rockets can still be utilized with scratch-built rockets. Scratch-built rockets tend to be heavier than rockets built from educator kits meaning more powerful engines will be needed to successfully launch the rocket.

3. Using Model Rocketry in a Science Course for Non-Majors

3.1. Course Background

Voyages to the Terrestrial Planets (VTP) is an introductory planetary geology course and associated lab section open to non-science majors at Mercyhurst University. Course content includes the origin of the solar system and emphasizes the characteristics of the terrestrial planets [including the asteroid belt]; motivating factors and methods for exploring space are also discussed. Course enrollment typically ranges between ~15 to <30 students, ~75% to 90% of whom have never taken a college-level science or math course. Students in the course are typically majoring in a non-science and are taking VTP as part of their general education requirements; however, some science majors (typically ~1% of course enrollment) do enroll in the course due to their general interest in space exploration. College-level math courses students in the course have taken typically vary from none to a 100 level college algebra or statistics course.

3.2. Model Rocket Module

As part of the lab section for VTP, I designed and implemented a module that involved the building and launching of model rockets. The specific learning objectives for the module are to: 1) utilize quantitative skills when answering a scientific question, 2) apply the scientific process when addressing a scientific question, and 3) recall general knowledge about planetary science. These are learning objectives similar to and motivated by objectives laid out for model rocketry lesson plans at the K-12 level [1] [2] [30]. I implemented this module during four iterations of VTP, but collected assessment data for only three of those iterations – Winter term 2013 (20 students); January 2014 (27 students), and Spring term 2014 (12 students). Each term when assessment data were collected for this module was different in its length. Winter term 2013 was 10 weeks long whereas January 2014 was a mini course (a J-term course) that took place over approximately four weeks and Spring 2014 was a 14 week course. In all three assessed iterations, Estes Industries brand educator bulk packs were utilized. Specifically, the Up Aerospace Spaceloft bulk pack (https://estesrockets.com/product/001793-up-aerospace-spaceloft-bulk-pack-12-

pk/) was used and purchased from a local hobby store (~$55); an educator's bulk pack of engines (24 engines) was purchased separately (~$60). A launch pad was purchased separately the first time the module was implemented; it was a one-time purchase. In addition to building rockets from a kit, students in the January 2014 and Spring 2014 iterations of this module also built rockets from scratch using common household items (e.g., a cardboard tube and a cap from a can of shaving cream).

In each of the three assessed iterations, the module took place over four-week period that involved four lab meetings. Each lab meeting was two hours and fifty minutes and consisted of an approximately 20 minute overview of that day's activities, how the activities fit into the overall model rocketry lab module, and the goals the students would be accomplishing by the end of the lab period. Students worked in groups of 3 - 4 depending upon class size. During the first lab period, students were provided an overview of the module with instructions and a rubric of how they were to be graded. Students also constructed their rockets during this period. Based on the engine types provided to them, the shapes of their rockets, and the weight of their rockets, the students then made predictions as to how high and fast their rockets would go. In between the first and second lab meetings, students had to design a hypothetical mission that their rocket would undertake. The mission destination could be to anywhere in solar system and students were provided a budget they needed to stay within. Mission destination and type (e.g., a rover vs. an orbiter) all impacted their mission cost; if students found they were going to go over budget, they had to write a half-page proposal with an explanation and breakdown of the additional monies they needed. Costs for specific aspects of the mission were provided to them. Students then presented on their mission and the data they collected in a 15 minute presentation during the last lab meeting of the semester.

During the second lab meeting, the groups launched their rockets. This was done on our university football field where the launch pad was spread on a tarp to collect any debris from the launch [e.g., igniters] and to provide extra protection to the field's artificial turf. Each group timed how long it took for their rocket to reach its apex and how long it took for it to descend back to Earth. Each group also used an altimeter tracker purchased from Estes Industries to track the maximum height he rocket reached; students stood 100 yards from the launch site and measured the angle between themselves and the rocket's apex. Each group launched their rocket once.

The third lab meeting consisted of crunching the data collected from the previous week and synthesizing it. Specifically, using Pythagorean's theorem, students calculated the maximum height their rockets attained based on the angle they measured using the altimeter tracker. Based on the time it took for the rocket to reach its apex and to descend back to Earth, students calculated the average upward and downward velocities of their rockets. Students then synthesized these data into a written lab report and 15 minute oral presentation [both due during at the time of the fourth lab meeting]. The lab report was a typed five-page paper that synthesized all of the data collected from their launch and compared their data to one real-world rocket (e.g., the Saturn V rocket). The oral presentation was a verbal explanation of their lab report also had to explain their hypothetical mission including the mission objective, science questions to be addressed, and why those are important questions. This module ultimately served as the lab final for the course.

All parts of the lab module and the rubric used to grade are available upon request from NPL.

4. Effectiveness of the Lab Module

4.1. Assessment Instruments

To assess the effectiveness of this lab module in model rocketry to meet the stated learning objectives, students performed two assessment activities. The first was a pre-test/post-test activity that measured the amount of content students gained over the four weeks of the module and the second was an affective questionnaire where students self-reported attitudes from before and after the lab module. The pre-test/post-test consisted of 17 questions and was divided into three major categories: 1) understanding of the scientific process; 2) general knowledge, or facts, about planetary science; and 3) quantitative skills, specifically algebra, trigonometry (Pythagorean's Theorem) and graph reading. The pre-test was provided during the first lab meeting of the module and the post-test was provided the day students gave presentations on their hypothetical mission in lab (fourth lab meeting). The affective questionnaire was taken at the same time as the post-test. In the questionnaire, students were asked to rank on a scale from one to five their interest in science, confidence in science, understanding of science, and understanding of how planetary missions are planned and conducted from before and after the lab module. A score of one indicated no interest or understanding and a score of five indicated extremely high interest or understanding.

After the completion of each term and after final student grades were submitted, the pre-tests and post-tests were graded and responses to the affective questionnaires were tabulated. The mean differences between the pre- and post-test scores were then calculated for the test as a whole (**Table 1**) and between each of the three test categories (**Table 2**). The mean differences between each of the four areas examined in the affective questionnaire were also calculated (**Table 3**). Two-sample t-tests using IBM's Statistical Package for Social Sciences (SPSS) program were then performed on the mean score differences for both the pre-test/post-test and the affective questionnaire from before and after the module (**Tables 1-3**).

4.2. Results

Pre-test/Post-test scores

In all three terms, students demonstrated an overall increase in learning over

Table 1. Summary of scores from pre/post tests.

When course was taught	# of students	Average pre-test score (points)^	Average post-test score (points)^	Mean difference (points)	Standard deviation	Paired t-test p-value*
Winter 2013	20	9.4	12.2	2.8	2.58	0.000
January 2014	27	7.4	10.9	3.1	0.97	0.000
Spring 2014	12	8.3	10.6	2.3	1.92	0.019

^Both the pre and post test scores were taken out of 17 available points; *Alpha value is 0.05.

Table 2. Summary of scores from pre/post tests based on content area.

Term^	Science Content Before	Science Content After	Quantitative Content Before	Quantitative Content After	General Knowledge Before	General Knowledge After
Winter 2013	2.65	3.88	4.20	5.39	2.64	2.92
Standard dev.:	1.42	0.86	1.92	1.62	0.82	0.73
*Change**:		1.23		1.19		0.28
t-test p-value%:		0.000		0.004		0.094
January 2014	0.70	1.77	1.43	1.77	2.21	2.90
Standard dev.:	0.50	0.58	0.95	1.05	0.83	0.75
*Change**:		1.07		0.34		0.69
t-test p-value%:		0.000		0.059		0.001
Spring 2014	2.67	3.55	3.21	4.25	3.10	2.76
Standard dev.:	1.21	0.84	2.09	2.50	0.74	0.81
*Change**:		0.88		1.04		−0.34
t-test p-value%:		0.011		0.031		0.049

^The number of students for each term is the same as reported in Table 1. *Change is the "After" score minus the "Before" score. %This score represents a two-tailed two-sample t-test with an alpha of 0.05.

Table 3. Summary of averages for each question on the affective questionnaire for the three terms examined for this module.

Term^	Science Interest Before	Science Interest After	Science Confidence Before	Science Confidence After	Science Understanding Before	Science Understanding After	Mission Understanding Before	Mission Understanding After
Spring 2013	3.10	4.03	3.19	4.13	2.81	4.25	1.69	4.06
Standard dev.	1.18	0.93	0.81	0.78	0.88	0.66	0.91	0.75
*Change**:		0.93		0.94		1.44		2.38
t-test p-value%:		0.000		0.000		0.000		0.000
January 2014	2.61	3.85	2.08	3.42	2.62	3.77	2.12	3.92
Standard dev.	1.13	0.70	1.17	0.57	0.96	0.58	1.05	0.83
*Change**:		1.24		1.35		1.15		1.81
t-test p-value%:		0.000		0.000		0.000		0.000
Spring 2014	3.08	3.69	2.46	3.31	2.85	3.77	2.15	4.00
Standard dev.	0.99	0.62	1.28	0.99	1.10	0.89	0.95	0.68
*Change**:		0.62		0.85		0.92		1.85
t-test p-value%:		0.055		0.009		0.002		0.000

^The number of students for each term is the same as reported in Table 1. *Change is the "After" score minus the "Before" score. %This score represents a two-tailed two-sample t-test with an alpha of 0.05.

the course of this module (Table 1). The largest gains occurred during the January 2014 iteration of this module (3.1 point increase with a standard deviation of 0.97) whereas the Spring 2014 iteration had the smallest point increase (2.3 point increase with a standard deviation of 1.92). Two-sample t-tests on these point gains showed that they were all statistically significant with the Winter 2013 and January 2014 terms learning gains being very statistically significant.

Content-wise, the largest increases in learning occurred in understanding the scientific process and with quantitative skills (Table 2). General knowledge about planetary science typically had the smallest learning gains with one term (Spring 2014) having a negative change in their general knowledge scores (−0.34 point gain). Two-sample t-test analyses on the point gains for these three content areas were mostly statistically significant. Specifically, all three terms had statistically significant increases in their understanding of the scientific process with Winter 2013 and January 2014 having very statistically significant increases. Although quantitative skills as a whole appeared to increase in all three terms, only Winter 2013 and Spring 2014 showed statistically significant increases in learning. Only the January 2014 term showed a statistically significant increase in student learning with the general knowledge content area.

Affective questionnaire

In all three terms, students self-reported increases in all four categories on the affective questionnaire (Table 3). The largest increases all came in understanding how planetary missions were managed and carried out where the average self-reported score changes ranged from 1.8 to 2.38. The smallest average self-reported score increases occurred with science interest where score increases ranged from 0.62 to 1.24. With the exception of science interest for Spring 2014, two-sample t-tests showed that all average self-reported point increases were statistically significant with the vast majority of the increases being very statistically significant.

5. Discussion

Results from both assessment instruments indicate this multi-week lab module had a positive impact on student learning. This is consistent with qualitative assessment of student learning using model rocketry modules at the K-12 level (e.g., [1] [18] [22]) and at the college level [27]. The largest positive impact appears to be in improving both an understanding science and quantitative skills; students' self-reported interest in science increased overall while their self-reported confidence in performing science increased significantly. Interestingly, a general knowledge of planetary science did not significantly increase over the course of this module while an understanding of how planetary missions operate increased significantly. To understand this impact on student learning, it is useful to go back to the learning outcomes for this module and the activities that were implemented. The learning outcomes for this module (and module activities that tied to that outcome) were: 1) utilize quantitative skills when answering a scientific question) build, launch, and determine height and velocity of the rocket); 2) apply the scientific process when addressing a scientific question (make predictions as to height and velocity of model rocket may attain; assess differences in predicted versus actual launch data); and 3) recall general knowledge about planetary science (designing hypothetical mission to a planetary body and presenting on it). Making predictions about a rocket launch, collecting launch data, and analyzing those data all map directly science understanding and quantitative skills parts of the module outcomes and which were directly tested for in the pre-test/post-test assessment. Recalling general knowledge about planetary science is a broader objective and, depending upon the theoretical mission students design, students may not be gaining content that was specifically tested on the pre-test/post-test assessment. Alternatively, designing a hypothetical may not be the most effective activity to increase general knowledge about planetary science; if true, then an alternative assignment may be needed to more effectively meet that objective.

It is also interesting to consider the possible role of the length of each term in which the module was implemented on student learning. Even though all three terms were different lengths, the length of the term did not seemingly have an impact on the overall content gain. However, the length of the term does seem to be a noticeable impact on the attitudes of students. To elaborate, the VTP in January 2014 was a four week course where this lab module represented a majority of the course effort. Students coming into that section of the class self-reported the lowest pre-module scores on the affective questionnaire, but had the largest increase in their self-reported score change. VTP in Spring 2014 was a 14 week course where this lab module represented less than a third of the course effort. Students in that section all had the lowest changes in their self-reported affective questionnaire scores. Perhaps the amount of effort this module requires as part of the overall course influences how this module impacts student attitudes, though student demographics (e.g., year in school and specific major, which were data not collected during this project) could also be a factor, though overconfidence should also be considered (e.g., [32]).

Ultimately, based on the overall small sample size on which this module was implemented (59 total students), it is difficult to draw wide overarching conclusions from the scores reported here [33]. However, the repeated statistically significant scores from before and after the module in both assessment instruments strongly suggests that implementing this lab module has positive impacts on a student's ability to learn science and quantitative content and could be an effective means of engaging students into content they may initially be reluctant to engage. This idea is supported by informal conversations with students during and after the implementation of this module. Students routinely indicated their enjoyment in this activity compared to lectures on science and math content. Multiple students (almost all male students) noted that they remembered building and launching rockets when they were younger and this activity was a link to those positive experiences. The recurrent theme in all conversations with students (and what is seemingly supported by the affective questionnaire data) was that they had positive experiences with science and math and that appears to have decreased their anxiety and fear on those topics.

6. Summary and Conclusion

To help increase science and quantitative content to non-science majors in an introductory science course at the college level, I have developed and implemented a multi-week lab module centered around model rocketry. Working in groups of 3 - 4, students design a planetary mission, build model rockets, and launch them. Data collected from the launch allows the students to calculate the height and velocities of their rockets. Testing of the learning gains of this lab module shows that it has statistically significant positive impacts on student learning, though more testing should be performed to increase the assessed population size. Overall, model rocketry—an activity routinely implemented at the K-12 levels—appears to also be effective at helping teach students scientific content and quantitative skills content at the college level while helping improve positive attitudes about science. The results described here are similar to those described by [27] [28] [29] for college level courses in that projects centered around the building and launching of a rocket can have positive impacts on students that can transcend their time in the classroom.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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