Evaluation of the California Institute of Technology (Caltech) Global Relay of Observatories Watching Transients Happen (GROWTH) Partnership for International Research and Education (PIRE) Fall 2018 Courses

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SMART START EVALUATION & RESEARCH

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Report contents

This report contains results from evaluation surveys conducted to assess two courses offered in Fall 2018:

- ASTR 310- Observational Astronomy Course at University of Maryland, College Park
- ASTR 680- Astronomical Techniques at San Diego State University

Analysis notes: Open ended responses were randomized to protect respondents' confidentiality.

ASTRO 310

Response Statistics

	Count	Percent
Complete	25	100%
Partial	0	0%
Disqualified	0	0%
Totals	25 out of 26 students	96%

Please rate your level of agreement with the following aspects of the course.

	Strongly disagree		Disagree		Neither disagree nor agree		Agree		Strongly agree		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture information was presented in a logical, step-by-step order.	0	0%	0	0%	0	0%	9	36%	16	64%	25
The use of telescopes and CCDs first-hand during observing enhanced my learning experience.	1	4%	0	0%	0	0%	5	20%	19	76%	25
The use of real world data was valuable to my learning.	0	0%	0	0%	1	4%	8	32%	16	64%	25
The opportunity to collect my own data was useful to my learning.	1	4%	0	0%	0	0%	7	28%	17	68%	25
Instructor handled student questions well.	0	0%	0	0%	0	0%	1	4%	24	96%	25
Instructor could identify and address student concerns about the material.	0	0%	0	0%	0	0%	2	8%	23	92%	25
Instructor was available to provide assistance during office hours.	0	0%	0	0%	2	8%	3	12%	20	80%	25
Instructor demonstrated enthusiasm for the subject matter.	0	0%	0	0%	0	0%	2	8%	23	92%	25
Instructor had a strong command of the subject matter.	0	0%	0	0%	0	0%	2	8%	23	92%	25

Please rate your agreement with the following statements: This course…

	Strongly disagree		Disagree		Neither disagree nor agree		Agree		Strongly agree		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Increased my understanding of the research process in astronomy/astrophysics.	0	0%	0	0%	0	0%	5	20%	20	80%	25
Increased my interest in becoming an astronomer.	1	4%	0	0%	3	12%	6	24%	15	60%	25
Increased my overall knowledge of astronomy/astrophysics.	0	0%	0	0%	0	0%	8	32%	17	68%	25
Increased my knowledge of the fundamentals of modern observational photometry, astronomy, and spectroscopy.	0	0%	0	0%	0	0%	5	20%	20	80%	25
Increased my knowledge of limitations of observational data and the data reduction process.	0	0%	0	0%	0	0%	8	32%	17	68%	25
Increased my ability to explain how typical optical telescopes and CCDs work.	0	0%	0	0%	0	0%	9	36%	16	64%	25
Increased my ability to compare capabilities of different optical systems of telescopes and CCDs.	0	0%	0	0%	1	4%	11	44%	13	52%	25
Increased my ability to utilize large data sets to formulate a question that can be answered using the data set.	1	4%	0	0%	1	4%	10	40%	13	52%	25
Increased my ability to manipulate and search large data sets to answer the generated question.	1	4%	0	0%	2	8%	10	40%	12	48%	25
Increased my ability to create and adapt MATLAB code.	0	0%	0	0%	6	24%	9	36%	10	40%	25
Increased my ability to communicate research results effectively, in scientific papers and talks.	1	4%	0	0%	0	0%	7	28%	17	68%	25
Increased my ability to collaborate with other researchers productively.	1	4%	0	0%	2	8%	7	28%	15	60%	25
Increased my ability to contribute to different parts of the research project process.	1	4%	0	0%	0	0%	9	36%	15	60%	25
Increased my interest in astronomy/astrophysics research.	1	4%	0	0%	1	4%	9	36%	14	56%	25

Has your participation in this course impacted your decision to remain in your major or change your major?

Value	Percent	Count
Yes	36%	9
No	64%	16
Totals		25

Yes, in what ways?

Response
I'm more interested in experimental and observational astronomy
It has shown me that I may want to be an astronomer, but I need a little more. Like engineering.
From this course, I would like to stay within astronomy as I have now experience with various aspects of observational astronomy
It has kept me interested in studying astronomy.
It has made me more enthusiastic about astronomy
I am enthused to keep going with the major
Taking this class reinforced my knowledge and made me certain that I wanted to become an astronomer.
I wasn't sure if I wanted to be a theoretical astrophysicists, and I really had no idea how the observational astronomers did what they did, and I really like the process, so it really solidified me in wanting to be an astronomer of some kind, most likely on the observational side.
The class gave me first hand experience.

No, please explain.

Response
I always planned to remain in the major and this class didn't change that.
It did not have any effect
I was already set on remaining in this major,
Makes me question if I want to be behind a computer all day for my career. I like talking.
Astronomy
The course didn't move me to change my major. Before and after the course I was fully committed to remaining in the major
and this class did not impact the decision as I already knew what I was doing.
This course was great and informative, but outside factors dictated my need to change majors.
Desire to stay in Astronomy unchanged.
I was already an astronomy major and I still am
My interest level in astronomy did not change
I'm a senior and switching majors is not an option so this course could not effect that.
Astrophysics, maybe cosmology or observational I don't know yet
I started out wanting to be an astro major and I still want to be an astro major
I still love astronomy. That hasn't changed.
I was confident in my decision beforehand
PhD, astronomy
I wanted to stay in the major before, and I still want to stay in it.
I planned on staying the astronomy major either way but it was very interesting.

Are you interested in pursuing graduate school?

Value	Percent	Count
Yes	84%	21
No	16%	4
Totals		25

What degree and field?

Response
Astrophysics
Ph. D. In Aerospace Engineering or Astronomy
Astronomy
Astronomy or Physics, PhD
Physics or astronomy
Something related to astronomy.
PhD, astronomy
Physics
Aerospace engineering, space probe design
Astrophysics, maybe cosmology or observational I don't know yet
Physics
Ph.D. and physics or astronomy
PhD in astronomy/astrophysics
PhD in astrophysics
PhD in Astrophysics or Heliophysics/Plasma Physics
Astronomy PhD
Planetary Science
Astrophysics
Astronomy, PhD
MS/PhD Astronomy/Astrophysics
I have not though about exactly which degree, but I would prefer a more theoretical/analytical field rather than an observational one

Has participating in this course affected your interest in pursuing graduate school?

Value	Percent	Count
Yes	28%	7
No	72%	18
Totals		25

Yes, in what ways?

Response
It has increased my interest in grad school
Helped me understand that I like research
Increased my interest in learning more and doing more research
Interest in instrumentation grew
Made me want to peruse it
I know better what subject I want to pursue
It made me more aware of exactly what is expected of astronomers, and helped me find what I would and would not enjoy doing in graduate school. It also reinforced the idea that graduate school is a logical step to becoming the kind of astronomer I wish to be.

No, please explain.

Response
None
It had no effect
It just didn't
I've always planned to go to grad school.
I knew that I was going to go to grad school and this class didn't really change that
I do not have the grades.
I already wanted to go to grad school and still do.
I already wanted to go to graduate school
I am still planning to apply to grad school.
I already planned on going
I wanted to pursue it before, and I still want to pursue it.
This course didn't affect my intentions vis a vie graduate school
I've been set on graduate school since my first semester
I have always been interested.
Already had plans of attending grad school.
I already knew I did not want to go to grad school and this did not change my mind.
I've never been interested in Grad School due to financial concerns.

How has this course impacted your interest in becoming an astronomer?

Response
It has shown me that direct research isn't what I want to do.
I have learned a lot from the course so that I am knowledgeable in many aspects from observational astronomy that I could possibly apply in future jobs/internships.
Gave me first-hand research experience and introduction to some of the things observational astronomers actually do.
It has maintained my interest.
I don't know how much I like the coding
Very positively, I really enjoy the study of astronomy.
I impacted the type of astronomer I want to be, but I always wanted to be an astronomer
I really loved the data that we had to work with, and want to do that more!
Yes, it gave me firsthand experience of observing. Which I enjoyed.
Yes; it reinforced how much I enjoy learning about space and astronomy.
I had never done observations before and found it really interesting.
It has not, I was already interested
No
It had no effect
Strengthened it
I'm more interested in getting my own telescope and doing amateur astronomy
It didn't change my interest but it gave me knowledge on what to expect
I am not going to graduate school so I most likely will not become an astronomer. Since this course did not change my opinion on graduate school it did not change my interest in becoming an astronomer.
Increased the likelihood that I follow through with my intended career path of becoming an astronomer
I know I do not want to be an observational astronomer and I prefer doing coding and computational stuff.
Unchanged
It has given me an appreciation for how observations are made and used.
I loved the researching and I love using the telescopes. Even staying out till 2:00am I was living for it
I was able to learn a lot about what astronomers do and I enjoyed very much doing it all.
I learned much more practical knowledge in observational astronomy.

How has this course impacted your understanding of the research process?

Response
It has enhanced my understanding of the research process
It allowed me to work through multiple research projects of different kinds
It increased my understanding of observational astronomy
yes, it demonstrated the steps and revisions needed for a paper.
Yes; I believe I am much more knowledgeable in the collection of data and analysis of data now.
It has given me a deeper understanding of the process of astronomical research
We made some simple hypothesis and even with those mall goals there's a lot more that goes into research than I originally thought.
Unchanged
I understand it much better now having actually participated in it.
I learned a lot about data acquisition and the post research stuff, ie papers, talks, etc.
Before I took this class, I didn't know exactly what all that peer review was about, or how hard thinking of a good science question is!
It has helped me supplement research outside of class, to better use coding and statistics in my work.
I don't think it has.
I know all of the steps to observe my own star, as well as getting data on already observed stars, which is a huge part of research
It has increased my knowledge of the research process.
I understand the whole process much better now
I knew very little before. Now I feel much more qualified to do research.
I have a much better grasp on how research proposals and papers operate.
Not too much, I have four years of experience with research already.
Hugely since I had never done research but now I have
A lot more goes wrong than I was expecting.
A lot! I really appreciate it
Greatly! I have a better understanding of the process by how Melissa structured it.
Gave me good experience
I have a deeper understanding of it.

Are you interested in participating in astronomy/astrophysics research projects? Please explain how this course impacted your interest.

Response
Yes, I enjoyed learning about the process and would like to continue building research skills
No.
Yes! I didn't know I loved combing through databases before I took this course.
I am, this course acts towards that
Yes I am very interested, and this course has made me realize I really enjoy the research process
Yes, I liked being out at night at the observatory.
Yes I am. This course helped show me how fun research is.
Yes; the projects done in class intrigued me even if they were difficult, leading me to believe I would enjoy research projects.
Yes I am! I really like the communication and learning process
Yes, I am interested. This course made me interested in observing and working at the observatory.
Yes, possibly something with observational astronomy based on what was taught in this course.
I am. First hand experience with observation did influence my interest in a less theoretical aspect of astronomy.
Yes. I have always been interested but now I have a better idea of the process.
I did not enjoy observing in visible light so I will not pursue this specific field
I would say my interest is slightly heightened as I now know what it entails and that I can do it.
I have become more interested in participating in meaningful astronomy research.
Yes, now I know I enjoy it and can do it
Yes I am. This course provided me with more information about how to perform the research itself, which was helpful.
This class made me realize that I have enough knowledge of the material to actually write a research paper
Yes, observational work was a lot of fun
Yes. I was interested already, but the course gave me first hand experience.
Yes. This was interesting
Yes. I want to do more observations now.
Yes, I really enjoy the observing and research process.
Yes. It didn't.

Please provide any suggestions you have to improve the course.

Response
Make challenges more within our capabilities
I greatly enjoyed the material but wish that the ELMs page had a more clear layout ("Modules", "Pages", "Assignments", "Files" are all confusing and I would frequently forget which location had the readings and files and pages I needed to see before lectures)
Require people to learn the material, half of my group is checked out and it has really hurt my experience.
Doing the projects at the same time is difficult but effective. If there were other ways of getting secondary researchers involved, that could help give students a more robust understanding of different research processes
The book was kind of bad at explaining things. Would be nice to have had a specific explanation of how exactly to go about the string-length process of period determination or a list of image calibration steps.
Have handouts for each step of writing that we needed. I was never quite sure what each deliverable needed. I knew it was somewhere, but I always had trouble finding it.
I would suggest making the Challenges a bit easier.
Be consistent with the amount of challenges dropped as stated initially. If scores are low I would suggest a curve instead of a drop as it felt my work didn't matter and that was frustrating.
Possibly talk about more careers and opportunities using the skills taught in this course for students to be more likely to apply for.
Sometimes, when looking back on previous lectures, it is hard to gather exactly what was went over. Perhaps a kind of record of the answers to group questions that were had in class.
Maybe an occasional homework to reinforce the information.
Less revision of the paper.
more feedback on my group/partners to keep them accountable. also I felt like secondary researchers had very little input on their project
I would make it a 2 semester course and go into more depth on each topic.
Maybe have more opinions to research other types of observational astronomy, like spectrology.

Six respondents did not provide suggestions, two offered positive comments, one noted the challenge format was odd but that they liked the course, and one felt he/she did not learn as much about the project while serving as a secondary researcher.

With which gender do you most closely identify?

Value	Percent	Count
Male	52%	13
Female	40%	10
Prefer not to answer	8%	2
Totals		25

With which ethnic and racial background(s) do you most identify? (Select all that apply)

Value	Percent	Count
Asian	4%	1
Black or African American	4%	1
Hispanic or Latino	8%	2
White or Caucasian	80%	20
Prefer not to answer	8%	2
Totals		25

Are you a first-generation college student (a first-generation college student is an individual whose parents never enrolled in post secondary education)?

Value	Percent	Count
Yes	12%	3
No	84%	21
Prefer not to answer	4%	1
Totals		25

Key findings

- The majority of respondents strongly agreed that the instructor handled student questions well (24 respondents), demonstrated enthusiasm for the subject matter (23 respondents), and had a strong command of the classroom (23 respondents). Twenty-four respondents agreed or strongly agreed that the use of telescopes and CCDs and the opportunity to collect their own data were valuable to their learning.

- The majority of respondents strongly agreed that the course increased their knowledge in areas that related to course objectives, especially understanding of the research process in astronomy/astrophysics and knowledge of the fundamentals of modern observational photometry, astronomy, and spectroscopy (20 respondents).

- Fifteen respondents strongly agreed that the course increased their interest in becoming an astronomer, noting that it confirmed their interest in astronomy or helped them narrow it down to which field of astronomy they wish to pursue. Twenty respondents were interested in pursuing graduate school, sharing that they had already planned to pursue graduate school before taking the course.

- Twenty respondents indicated that they were definitely interested in participating in future astronomy/astrophysics research, with the majority sharing that the hands-on data collection and research in this course encouraged them to pursue more research.

- Four students noted that they did not have the best experiences during the group projects and/or as secondary researchers. More opportunities for students to provide feedback on their teammates and encouraging more involvement among all team members would have been preferred during the course.

Recommendations

- The instructor should continue to offer the opportunity for students to use real world data and collect their own data, as respondents appreciated the hands-on data collection experience, especially sharing that it helped them gain more of an understanding of the research process and a deeper interest in the subject.
- When assigning groups for projects and activities, ensure that there is a motivation and monitoring system in place so that all students are incentivized to participate to their fullest. This can be done through team members assessing each other's contributions and providing feedback to one another midway through the course.
- The instructor should consider implementing some of the various suggestions to improve the course provided by respondents. These include having hands-outs for the writing assignments, organizing the ELMs page to be more understandable to students, and implementing challenges to be at a level of difficulty for all students.

ASTRO 680

Response Statistics

	Count	Percent
Complete	4	100%
Partial	0	0%
Disqualified	0	0%
Totals	4 out of 5 students	80%

Please rate your level of agreement with the following aspects of the course.

	Strongly disagree		Disagree		Neither disagree nor agree		Agree		Strongly agree		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture information was presented in a logical, step-by-step order.	0	0%	0	0%	0	0%	2	50%	2	50%	4
Having special events, such as field trips, enhanced my learning experience.	0	0%	0	0%	2	50%	2	50%	0	0%	4
The use of real world data was valuable to my learning.	0	0%	0	0%	0	0%	1	25%	3	75%	4
The opportunity to collect my own data was useful to my learning.	0	0%	0	0%	0	0%	1	25%	3	75%	4
Instructor handled student questions well.	0	0%	0	0%	2	50%	1	25%	1	25%	4
Instructor could identify and address student concerns about the material.	0	0%	0	0%	1	25%	1	25%	2	50%	4
Instructor was available to provide assistance during office hours.	0	0%	0	0%	0	0%	2	50%	2	50%	4
Instructor demonstrated enthusiasm for the subject matter.	0	0%	0	0%	0	0%	0	0%	4	100%	4
Instructor had a strong command of the subject matter.	0	0%	0	0%	0	0%	0	0%	4	100%	4

Please rate your agreement with the following statements: This course…

	Strongly disagree		Disagree		Neither disagree nor agree		Agree		Strongly agree		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Increased my understanding of the research process in astronomy/astrophysics.	0	0%	0	0%	0	0%	1	25%	3	75%	4
Increased my interest in becoming an astronomer.	0	0%	0	0%	0	0%	2	50%	2	50%	4
Increased my overall knowledge of astronomy/astrophysics.	0	0%	0	0%	0	0%	1	25%	3	75%	4
Increased my knowledge of UNIX.	0	0%	0	0%	1	25%	2	50%	1	25%	4
Increased my knowledge of programming with Python.	0	0%	0	0%	0	0%	1	25%	3	75%	4
Increased my knowledge of basic statistics, including probability distributions and error analysis.	0	0%	0	0%	0	0%	2	50%	2	50%	4
Increased my knowledge of basic astronomy concepts and definitions.	0	0%	0	0%	0	0%	2	50%	2	50%	4
Increased my knowledge of astronomical software	0	0%	0	0%	0	0%	1	25%	3	75%	4
Increased my knowledge of image processing and photometry	0	0%	0	0%	0	0%	0	0%	4	100%	4
Increased my ability to reduce and analyze data to produce new astrophysical measurements.	0	0%	0	0%	0	0%	1	25%	3	75%	4
Increased my ability to process data using student-developed code.	0	0%	0	0%	0	0%	0	0%	4	100%	4
Increased my ability to produce written and oral reports on my work.	0	0%	0	0%	0	0%	1	25%	3	75%	4
Increased my ability to operate the research telescopes at the Mount Laguna Observatory.	0	0%	0	0%	0	0%	0	0%	4	100%	4
Increased my excitement and passion for astronomy/astrophysics.	0	0%	0	0%	0	0%	1	25%	3	75%	4
Increased my interest in astronomy/astrophysics research.	0	0%	0	0%	0	0%	1	25%	3	75%	4

Do you believe that participating in this course has affected your interest in pursuing further studies, and/or a career in a STEM-related field?

Value	Percent	Count
Yes	100%	4
Totals		4

Yes, in what ways?

Response
It exposed me to the various techniques that astronomers used in the research process and has further encouraged me to pursue the field.
It makes me want to go more into observational astronomy rather than theoretical.
Positively. It has raised my interest to new heights
My interest has increased, since I am now more comfortable with analyzing and processing scientific data.

No, please explain.

No responses

Do you plan to enroll in a PhD program in astronomy/astrophysics?

Value	Percent	Count
Yes	100%	4
Totals		4

How has this course impacted your interest in becoming an astronomer?

Response
It has increased here also, since the astronomical techniques we have practiced in the course have made me comfortable with carrying out astronomical observations and analysis.
Made me appreciate the observational/experimental side of astronomy more.
It has increased my interest in becoming an astronomer. I have learned many new things that I would like to explore in more detail.

How has this course impacted your understanding of the research process?

Response
This class taught me the value of learning to code for astronomy research. While I had prior research experience using Python, I quickly realized that my methodology was rudimentary at best. It was at first frustrating, but as the class continued on, and my skills advanced, I wanted to continue to hone my new knowledge and apply it to work outside of the classroom.
It has helped me learn how to read and gather information better, and also appreciate the research process more as a whole.
It has shown me the difficulties of data analysis and reduction. It has also improved the way I write reports on a research project.
It gave me first hand experience of the process.

Are you interested in participating in astronomy/astrophysics research projects? Please explain how this course impacted your interest.

Response
Yes. The techniques in this class will prepare me for future research. My interest for research was raised to new heights
Yes, but I am currently unsure about what these projects will be.
It made me more interested because it built a strong foundation for me to contribute to research projects.
Yes, I am very much interested in participating in astronomy/astrophysics research projects. While the course was a bit one-sided in terms of research aims (i.e. supernovae), it exposed me to the various techniques that astronomers used in the research process and has further encouraged me to pursue the field. Walking out of the class having the ability to calculate the age of the Universe and the rate of expansion and having the opportunity to work with the MLO 40 inch telescope were both amazing feelings.

Please provide any suggestions you have to improve the course.

Response
A section or project that involves spectroscopy. Possibly a bit more practice with Bayesian statistics with more complicated models.
None
My biggest suggestion would be to grade assignments and projects in an efficient manner, so as to use them as a guide and to correct further mistakes. Additionally, while the professor was very open to answering questions, it was difficult to find a time to meet, which had the possibility of impacting outcomes.

With which gender do you most closely identify?

Value	Percent	Count
Male	75%	3
Female	25%	1
Totals		4

With which ethnic and racial background(s) do you most identify? (Select all that apply)

Value		Percent	Count
Asian		50%	2
Hispanic or Latino		25%	1
White or Caucasian		25%	1
Totals			4

What is your current area of study (degree and field)?

Response
M.S. Astronomy
I am pursuing a Masters of Science in Astronomy, and currently have a Bachelor of Science in Astrophysics.
MS, Astronomy
Master of Science, Astronomy

Are you a first-generation college student (a first-generation college student is an individual whose parents never enrolled in post secondary education)?

Value		Percent	Count
No		100%	4
Totals			4

Key findings

- Respondents agreed that the instructor demonstrated enthusiasm for the subject matter and had a strong command of the subject matter; however, responses were mixed regarding the instructor's ability to handle student questions well and identify and address student concerns about the material.

- The majority of respondents agreed to strongly agreed that the course components helped increase their knowledge and skills in areas related to course objectives. All respondents agreed or strongly agreed that they increased their understanding of the research process in astronomy/astrophysics, their overall knowledge of the subject, and ability to process data using student-developed code.

- All respondents shared that taking ASTR 680 increased their interest in pursuing a career in astronomy and in becoming an astronomer. They attributed this to the exposure to the larger field and the hands-on experiences in the course. Additionally, all respondents intended to pursue a PhD in astronomy/astrophysics.

Recommendations

- The instructor should continue to offer the opportunity for students to use real world data and collect their own data, as respondents appreciated the hands-on data collection experience, especially sharing that it provided them with new techniques and made them more interested in pursuing a career/research in astronomy to apply their knowledge.

- The instructor should also ensure that he/she completely addresses student questions and concerns about course material. This can be done through dedicating an allotted time during certain class days to answer student questions. The instructor may also consider providing more detailed feedback to students through assignments and projects.