2019 Astronomy School Evaluation

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Prepared by

Carly Raasch, MA; Leanne Tortez, PhD; Cindy Villavicencio, MA

Smart**S**tart
EVALUATION & RESEARCH

4482 Barranca Pkwy, Suite 220, Irvine, CA 92604
Phone: 949.396.6053

Response statistics

44 out of 48 participants responded to the survey for a 92% response rate.

Analysis notes:
- Open-ended responses were randomized to protect respondents' confidentiality.
- For one open-ended question (i.e., goals for attending GROWTH), a summary of themes is provided before the comments are presented.

Respondents' perceptions of the GROWTH Astronomy School's influence on skills and abilities

	Strongly disagree		Disagree		Neither disagree/agree		Agree		Strongly agree		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
The Astronomy School increased my knowledge of multiwavelength follow-up observations of transient events.	0	%	0	%	1	2%	16	36%	27	61%	44
The Astronomy School increased my ability to use practical tools for multiwavelength follow-up observations to transient events.	0	%	0	%	1	2%	11	25%	32	73%	44
The Astronomy School increased my understanding of my research area.	0	%	2	5%	5	11%	24	55%	13	30%	44
The Astronomy School increased my knowledge of new tools that will enable me to achieve my research goals.	0	%	0	%	0	%	13	30%	31	71%	44
The Astronomy School increased my interest in a new area of observational astronomy.	0	%	0	%	4	9%	17	39%	23	52%	44

Note: Darker shades of blue indicate higher counts of respondents who selected that rating.

Summary of themes for respondents' goals in attending the GROWTH Astronomy School

Learn new skills
- Respondents attended GROWTH to learn new skills related to their area of research, particularly tools that may help them with their research (e.g., data analysis reduction techniques, techniques for wavelength observations, Python, PSFEx, etc.).

Increase knowledge of astronomy areas
- Respondents wanted to better understand areas of astronomy (e.g., observational astronomy) and increase general knowledge of astrophysics and astronomy.

Increase opportunities for networking
- Respondents stated they wanted to meet experts, researchers, students, and develop friendships with those with similar interests.

Note: Randomized raw responses are presented by theme on the following slides.

Goal for attending GROWTH Astronomy School: Learn new skills

Response
To get skills and knowledge about analyzing multi wavelength data
to get skills to analyze the astronomical data.
Learn new skills related to observations at other wavelengths
Increased programming skill intro to radio, xray and machine learning
I wanted to learn time domain astronomy skills for future research projects both during and after graduate school.
I wanted to obtain as many new tools for data reduction/analysis as possible.
Become more proficient with the relevant technologies.
Better skill for dealing with LIGO events
To gather tools to improve my research skills and solve problems.
Learning new tools to help my research
Mainly to see the practical applications of python to aid in research.
To learn more python tools for astronomy research and learn about observational astronomy in other wavelengths.
My main goal was to increase my knowledge of data analysis tools across the electromagnetic spectrum.
To better understand the underlying tools of my research.
To develop my understanding of data reduction principles and techniques for different wavelength observations, and learn about useful tools for this.
The improvement of my knowledge especially regarding the use of new tools, such as PSFEx, and python packages in all modules.
To learn the practicalities and basics of Astronomy analysis techniques.
To develop my understanding of data reduction principles and techniques for different wavelength observations, and learn about useful tools for this.
Gain reference materials and familiarity with python codes that I may be able to use in future research
My main goal was to gain the fundamental knowledge and approaches on analyzing data in the different fields in Astronomy
the main goal for me was to learn more about all the different computational tools used in astronomy research and I think this program exposed me to a wide arrange of methods/tools
My main goal was to expand my horizons and get new skills that may or may not apply to my current research interests.

Goal for attending GROWTH Astronomy School: Increase understanding of astronomy areas

Response
Learn more about multimessenger astronomy, follow-up and data analysis. I have very little idea about radio and X-ray.
Explore areas of research not limited to only photometric observations.
I wanted to understand the capabilities and limitations of observing at wavelengths other than the radio spectrum I am used to.
My main goal was to understand tools that I could apply to my research, as well as, get insight into other areas in astronomy and ideas for how to tackle new projects.
To learn more about time-domain astronomy at wavelengths other than optical astronomy.
Become more familiar with multiwavelength astronomy, exposure to new scientific concepts and techniques (such as X-ray and radio astronomy lightcurves), gain a deeper understanding of the basic principles of observational astronomy.
To have a better understanding of all the various research areas and observation techniques in Time Domain Astronomy
I wanted to learn about processing of data from ground based telescopes. The modules focused on astroplanning, image subtraction and spectroscopy were particularly useful for me.
to increase general knowledge of astrophysics/astronomy, especially for the different kinds of transients and the methods used to observe and analyse them
To increase my understanding of transient study and optical followup of transients.
I am developing software for recommending follow-up strategies based on characteristics of the particular transient. My goal in attending GROWTH was to understand what follow-up even looks like in multiple bands.
To learn about current research avenues in multi-messenger astronomy, in particular EM follow-up of GW events which is an area I'm interested in.
I'm a first year graduate student and I am potentially interested in FRBs/short-duration radio transients in general. I thought this summer school would help me understand the kind of work people in the field of transients do and introduce me to the type of skills I'll need to develop to be involved in transient follow up
learning about follow up of transient events and gaining new computational tool to solve problems.
My research is mainly observational, and since I am just getting started in this field, I thought this would be a great opportunity to learn more about all the different research techniques.
My goal was to see more of what was being done in current research.

Goal for attending GROWTH Astronomy School: Networking

Response
To learn the usage of astronomy modules and build friendships with other professionals in this field
Obtain new skills, on data analyses, meet new experts and friends working on these areas
Network with academics in this area.
I wanted to learn more about observational astronomy and meet active researchers and students
Learn about interesting topics, to obtain tools that could help me during my career. And to know and to share with new people that works in similar areas

Most beneficial concepts, topics, or techniques learned by respondents at the GROWTH Astronomy School

Response
Image subtraction was super useful and something i had never heard of before
I interested in the topic of light-curve analysis.
Light curve
Difference imaging techniques, spectral data reduction techniques.
The spectra module
How to perform observations at a telescope (which I will be doing next week!) and how to take basic astronomical images (flats, biases, etc.)
Image data reduction was particularly helpful for my research. Particularly, finally getting a chance to get into some details about widely used software such as SExtractor was very helpful
Using astropy tools as an alternative to writing complicated python scripts or code.
Photometry and spectroscopy
The lecture on gravitational waves
Image and spectral analysis in optical bands were a new thing that helped me a lot. Also, I learned the power of statistics in Astronomical research
The most beneficial was the radio and x-ray sessions, because I was interested in learning about data reduction in x-ray. In particular learning about x-ray data reduction compare to optical.
Spectral reduction; astroquery
astropy tools
A lot of the first day stuff was excellent- namely image reduction and subtraction.
optical data reduction
The modules on planning observations, gravitational wave localization, and radio analysis were the most useful. The first 2 covered topics which I was very unfamiliar with and the latter provided an excellent cookbook for methods that are used across the spectrum.

Most beneficial concepts, topics, or techniques learned by respondents at the GROWTH Astronomy School cont.

Response
My favorite module was on spectroscopy, photometry and planning observations. These skills were particularly very exciting to learn since I can use them toward my academic research.
Localization of GW events and spectroscopy
Having modules to demonstrate techniques to analyze data.
Image reduction and subtraction and associated tools.
Learning how to work hands-on with optical images, learning additional astropy tools, learning the basics of how x-ray and radio astronomy is carried out.
Astropy modules
The most beneficial technique that I learned was "astroplan" which I did not know about and will help me to plan my future observation runs.
the most beneficial concept for me was lightcurve analysis because I had been working with lightcurves previously, but what I saw in this module was a lot more practical and will help further my current work in binary systems
image subtraction   radio
MCMC, sextractor, psfex, photutils
There were a lot of computational tools I had never come across before the school and which are extremely beneficial.
I felt like the photometry was really good as well as the use of skycoords to work with projections on the celestial sphere.
I really enjoyed learning about spectroscopy in Python because the only way I have seen it done before is through IRAF, which just seems like a pain! I also really enjoyed learning about image subtraction and reduction as these are other big components in my research.
learning to use the various python libraries/packages for each module
The spectroscopy lesson was very nice, because it was introduced in a fundamental and interesting way and the motivation for the software portion was quite strong. The observational tools in python are also a fantastic thing to have in my back pocket - I am not now an observer, but am more interested in it now than I was before.

Most beneficial concepts, topics, or techniques learned by respondents at the GROWTH Astronomy School cont.

Response
Reducing spectra with python!!! There are no good pipelines/tools that I can find that use python to reduce spectra and it was immensely helpful to have everything I need to build my own python spectra pipeline!
I really loved the image reduction and subtraction workshops. They covered a lot of super important software packages and skills that I was never even aware of before
As a graduate student interested in star clusters, there are several topics that are beneficial to me. With regards to the topic, I learned a lot on spectra and variable stars. With regards to techniques, all of the techniques taught in the modules are very beneficial. Even if it was not in my fields of interest, the debugging/troubleshooting is a very necessary skill, and the packages and approaches may come in handy in the future.
I found sessions on spectroscopy, lightcurve analysis, and image subtraction particularly useful. I was good to learn a thing or two about asteroids, as a person who is not working on them.
Period finding
I consider that all the modules are beneficial, but the most for me is image reduction and subtraction, photometry and spectra reduction.
I thought the light curve analysis and the image subtraction/reduction modules were very helpful.
I really enjoyed the X-ray section, it was something new and interesting to me. The lecture was also very helpful in that section.
I think the benefit of this program is getting to try new programming capabilities. Whether it 'sticks' in our head today or we have to look back at the modules, just knowing about the different options is extremely beneficial. I also think it is beneficial to learn about different topics (ie different techniques across wavelengths).

How respondents will use their gained knowledge and experience in future research

Response
using astropy tools to solve research problems
This will allow me to develop a framework to rapidly reduce optical data of newly discovered transients.
With the last module on radio astronomy that heavily relied on statistics and modelling, I think the knowledge I gained from it will definitely help out in my research.
Hopefully I will be implementing much of the optical imaging techniques in pursuit of my thesis, where I will be following up on DESI transients with an optical telescope
Depending on what field I choose, it may be valuable for data processing and image manipulation
This knowledge will help me to better understand the codes/pipelines that I currently use
This experience will guide my research interests in the future.
As mentioned, next week I'm observing at Palomar, so I will be using these skills.
Reducing data for followup of TDEs and AGN as part of my PhD thesis.
I will analyze optical and X-ray data that got simultaneously.
The new expertise I acquired during the astronomy school will be the pillars for my work in the variability study of AGN flares and neutrino follow up.
I'll be participating in the group for a new radio telescope at Owens Valley Radio Observatory (DSA), so I wanted these skills moving forward in transient detection with this instrument.
I will use image subtraction
Immediately, I'm using Sextractor and PSFex for my current project, and learned a little more about it. For the future, I hope to be able to interpret some spectroscopic data.
The things I learned at the GROWTH school will be immensely helpful in planning observing runs and reducing the data that I get from them.
I will be able to include radio data when fitting SEDs of galaxies.
I will be continuing my research in EM follow-up of GWs.
I don't know now

How respondents will use their gained knowledge and experience in future research cont.

Response
The utility to my research will be in thinking about the types of data reduction we did for different wavelengths, and figuring out how to integrate that into my software.
I will definitely keep all the jupyter notebooks from this class as a reference for when I am writing my one code later. I thought having multiple teachers showed different ways to approach programming challenges.
It will help me a lot with planning my future observation runs and will give me a reference for tackling new problems.
The school very nicely highlighted the importance and power of python. I have been using python as programming language, but the school helped me understand how I can make effective use of python to handle my data and related tasks. A big thank you for that. Transient search is another interesting topic, which I found useful for my work.
I have been writing an algorithm for a telescope and these modules will be of great importance to quickly and efficiently complete my work
I intend on applying what I've learned to analyzing TESS data and eventually on LSST data as that becomes available.
Not sure yet.
for me lightcurve analysis will be great but I also picked a new interest in radio astronomy
Most of these modules can be directly applied to my current academic research. I plan on using the notebooks and lecture notes as a reference and as a study guide to perform more elaborate techniques on my data and gain a better understanding of the whole process.
current research project on SLSN host modelling
The knowledge gained in this school will be helpful in my ongoing research project as I deal with observation, data reduction data subtraction on a regular basis. This helped me get more exposure to the things that usually happen in the background.
Ph.D research
In the future I would to use sextractor "with more confidence" and to use MCMC to fit light curves
I want to contribute towards low-latency follow-up observations of GW sources, and the techniques we learnt in producing accurate skymaps, identifying possible host galaxies, identifying transients w.r.t. reference images are important things to know.
My current research will require me to extract periods from ZTF lightcurve data, and I will also apply what we learned about reducing spectra once we do follow-up observations.

How respondents will use their gained knowledge and experience in future research cont.

Response
With my interest in large stars and large star formation, the information I gained from xray and radio astronomy will come in handy.
I'm really excited to start using these codes and modules to do my own image subtraction, reduction, photometry, and spectroscopy, as these are all key parts of my research.
streamlining future research and teaching by using newly found computational tools
I will be more efficient and confident when doing data analysis.
As a high energy astronomer, I will likely be involved in some work that centers on time domain astronomy, especially related to GW events. The exposure to these skills I got this week will help me to learn more quickly when I start new projects.
I won't be reliant on other people to reduce any optical data I may obtain
I will likely put the 3 above modules to use in my own EM follow-up of any potential GW sources.

Respondents' perceptions about the GROWTH Astronomy School program structure

	Strongly disagree		Disagree		Neither disagree/agree		Agree		Strongly agree		Not applicable		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
The sessions were organized well and in a logical manner.	0	%	0	%	1	2%	25	57%	17	39%	1	2%	44
The mixture of lecture and hands-on sessions was well-balanced.	0	%	2	5%	2	5%	15	34%	24	55%	1	2%	44
The lectures were the appropriate length of time for the content.	0	%	4	9%	4	9%	19	43%	16	36%	1	2%	44
The hands-on sessions were the appropriate length of time for the content.	0	%	9	20%	11	25%	15	34%	8	18%	1	2%	44

Note: Darker shades of blue indicate higher counts of respondents who selected that rating.

Respondents' preference to follow up observational techniques in multiple wavelengths or a particular wavelength

Value		Percent	Count
I would have liked a more focused program.		9%	4
I was content with the multiwavelength approach.		36%	16
I really appreciated the multiwavelength approach.		55%	24
Totals			44

Note: Respondents were asked to explain the preference they chose. Raw qualitative responses by each response option are presented on the following slides.

Preference to follow up observational techniques: More focused program

Response
For certain modules (for eg. radio and ligo skymaps), the time provided was simply not enough to gain a practical understanding of the underlying tools involved. Radio astronomy was completely new to me so I would've appreciated a deeper coverage of how observations are made rather than discussing the more general data analysis tools like MCMC.
would be better if the school could to last more days, and if the lectures were more detailed
A lot of the hands on sessions didn't feel appropriately scoped for the audience/time allotted. There were several that had an immense amount of code that we zoomed through and just compiled the cells without understanding what we were doing. It would have been better to cover less information and go more slowly so that we really understood. The main modules where this was an issue were the hands-on portions for the GW galaxy localization and radio astronomy.

Note: The fourth respondent who selected that he/she preferred a more focused program, did not comment to explain further.

Preference to follow up observational techniques: Content with a multiwavelength approach

Response
Some sessions I felt like I may never use, but it was good to be exposed to them
I specifically wanted the multi-wavelength approach so that I could learn a broad range of skills during this school. However, many of the more complex modules seemed very rushed and I barely understood anything from them. So, perhaps, a few fewer modules or an extra day for the school to give more time to some times and go slower could be good
It's tough to learn radio,xray,gamma wavelength research (and spectroscopy) in only 3 days, but I do appreciate the introduction and the techniques used in the short amount of time.
A little more emphasis on bands other than optical might be useful but the optical analysis was highly instructional
I think that the modules in some wavelengths, for example, require a bit more time. For instance, the radio astronomy module I personally thought needed more time to understand, since it required many more elaborate steps for completing. Another example is the optical spectroscopy module. I was hoping that since it's such an important topic, we had spent a bit more time in exploring the module and going through it in more detail.
The coding difficulty ranged quite wildly. Some modules had the code blocks filled out entirely, while others (particularly the last one) was entirely empty. As someone with only a semester of python coding experience, it was quite difficult to keep up in the time allotted. However, the solutions will provide valuable information which I greatly appreciate. Dr. Quimby never gave us solutions.
Some of the observational techniques were not directly exploring aspects of different wavelengths, for example, the radio section.
For me, the multiwavelength approach is necessary for GROWTH- it wouldn't really be GROWTH if it was just optical. That said, my focus is primarily in optical, so some of the non-optical stuff may not apply directly to me. Still the knowledge can't hurt.
In my opinion this school has been organized properly and all the modules have been extremely usefull and worthwhile
While I think that it was very beneficial for me to learn about other wavelengths that I don't work with on a day to day basis, by covering more topics, you can only learn so much. If this was specific to only one wavelength, I might not have attended.
Considering the constraint in time and the distribution of the days, I think some topic would need a longer hands-on sessions to be able to scratch the surface of the topic (i e: machine learning)
EM follow-up is multiwavelength. Focusing on any particular wavelength would not have made sense.

Preference to follow up observational techniques: Appreciated multiwavelength approach

Response
There were a couple of sessions where we completely ran out of time while working on the notebooks and had to rush through.
I believe it is important to know a little bit about each observational techniques. Afterwards, we can focus in on a particular technique in research. But as a student it is important to be well-rounded.
I appreciated discussing a broad range of wavelengths without getting too much into the weeds of a particular one
Highly satisfied
It was good to have a split as it meant there was not any major focus on areas I am already familiar and therefore minimising the time spent on less useful topics, whilst broadening my knowledge in many areas in which I have little experience.
I am interesting in exploring wavelengths beyond optical
Exactly what I needed
The multiwavelength aspect is the reason I came to the school. My only complaint is that sometimes the science and lectures seemed to get overshadowed by coding tasks that relied on your knowledge of python as opposed to engaging on the science subject.
My goal of the school was better understanding of multiwavelength astronomy
The work that I do is exploring follow-up observation in all wavelengths, and having not had much astronomy background I found the crash course in many different bands useful.
i think this set up for the program is best because we get exposed to different areas of research and it opens up our minds to new possibilities
I think that for some of the modules, the spectroscopy one especially, we did not have enough time. The more difficult/in-depth modules could be a little bit longer and the less complicated ones could be shorter to accommodate this.
I liked getting an introduction into a lot of different topics. It was the reason that this school really interested me.
As i am an undergrad, I don't have a ton of experience, so it was good to see a broad scope.
This was my main purpose of attending the school - to learn about wavelengths outside of optical.
I appreciated learning about multiple wavelengths but I wish we could have spend more time on each of the hands-on sessions in order to complete them.
To work with ZTF transients you need to have skills over all wavelengths. I think the information from each different wavelength will be very useful to me.
My main research is in optical/IR, but I am also really interested in X-ray and radio, so I was excited to learn more about these bands.
There wasn't enough time to complete some of the exercises.

Respondents' perceptions of the level of content presented

Value		Percent	Count
Too difficult		9%	4
Just right		89%	39
Too easy		2%	1
Totals			44

Respondents' perceptions of the Mt Laguna Observatory addition to the program

Value		Percent	Count
Not at all important		9%	4
Slightly important		14%	6
Somewhat important		32%	14
Very important		30%	13
Extremely important		16%	7
Totals			44

What respondents liked **most** about the GROWTH Astronomy School

Response
The mount laguna observatory trip
I liked the jupyter notebooks. They will be an extremely helpful tool that I can look back on later on if I need them.
I enjoyed the opportunity to communicate with the diverse community and the ability to ask for help when possible
I liked getting to meet other people in my field and especially those a few steps a head of where I am to look for inspiration and ideas.
The variety of modules presented.
The first few modules were excellent, as well as a chance to connect with other astronomers at a similar level to myself, doing similar things to myself.
It was very well organised. The sessions were planned out well .
That they began from basics of Astronomy analysis (and had exercises that were easy to follow)
I appreciate the notebooks which will be valuable resources moving forward.
I really liked the hands-on notebook sessions. This is where I learned the most.
I liked that there were hands on modules and that we will be able to keep the Jupyter notebooks we used in the lessons for reference while working on future projects.
Experience of English speaking
I enjoyed the hands on modules that introduced a topic then asked for you to try (i.e. the first day modules) as opposed to the long lecture style modules that had you try to do an activity at the end.
to be able to listen to each spearkers' talk.
The tutorials which were well organized and had high information density (particularly image calibration/subtraction, spectral data reduction). Also the tutorials which gave us practice with emcee and healpix - very useful!
The jupyter tuturials
The opportunity to meet likeminded early-career researchers
Organization of content. Interaction between students and lecturers/TAs.
Variety of content (photometry,spectroscopy,machine learning,galaxy crossmatching etc.)
learning new astropy tools during the modules

What respondents liked **most** about the GROWTH Astronomy School cont.

Response
The variety of speakers and their areas of interest.
I really liked the sessions that had coding exercises throughout the coding part of their session. The exercises that had you go back and alter parts of the code that you had already used in the introduction were extremely helpful in learning what the code did and how to use it.
I liked the format of the lessons - brief lecture introducing the topic, and then the coding portion. I've had many lessons before that are one or the other, and lacking either leaves a deficit. The program was well organized and I also appreciated that there are a few extra challenges we didn't cover that we can immediately go explore to solidify the concepts discussed.
The hands-on tutorials were my favorite part.
people from all over the world including very knowledgeable TA's and all the great experts.
I liked the Notebook tools provided.
I like the way TA were attentive and provided help through out the school. I liked how the lecturers delivered lectures. I am particularly a fan of Robert Quimby now. I loved his energy and the way he demonstrated reflection through grating and pixel arrays using phones.
Hands on sessions with jupyter notebook
It is difficult to learn about different topics in 3 days but the modules are GREAT for that, so they make us be awake and active.
lectures were great.
Learning about such a broad range of subjects and techniques in observational astronomy.
visiting a new country, and being able to interact and study alongside others from all around the world.
The TA's were super helpful with all difficulties. All lectures were well-delivered.
The lecture of photometry, the lecture of crossmatch to find sources of gravitational waves and the lecture of fitting light curves. Also the observation at Mount Laguna
- Challenging environment with a well-balanced amount of modules that were both easy and hard -- but overall very stimulating. - The applicability of the hands-on sessions will have on my current academic research- The TA's were extremely helpful! - New resources I never knew about!
everyone was very friendly and approachable
Help was readily available
Meeting the field and the hands-on nature of the programming / notebooks
I liked how we were able to explore a variety of topics and see how they were all connected.

What respondents liked **least** about the GROWTH Astronomy School

Response
a few of the modules were confusing
I think there were some difficult topics that I had no prior experience with and they were very rushed in the time of the modules (Machine Learning for example was really difficult to comprehend at all in a 2 hour time slot)
I think it would have been nice to have a little bit more down time, perhaps by making the school just one day longer, so we could have more time to focus on harder content or work on things on our own.
I didnt like that there was a full day and night(at the observatory) but the session started at 8:30am the next day. It would be nice if that session began at 9:00/9:30.
I have no particular complains
Some of the modules did not seem appropriately timed for the session. I would have like for people to focus in more to what the task was than to breeze through in the interest of time.
The food at the dorm canteen place was a bit mediocre/unhealthy. But I do appreciate that it was included at all!
Small classroom...
In certain hands-on sessions, the exercises left to the students were not very instructive. For example, during the machine learning module, the first student exercise was just to struggle with a dictionary. I don't think many of us made it past this exercise, and so we didn't really do any machine learning.
I did not like the coding sessions that had you run a bunch of code and then a huge exercise at the end. It was more overwhelming and I hadn't learned the code as we went through it.
Not all modules were planned well (and many of the exercises didn't follow logically from the lecture or previous exercises)
Sessions occasionally ran over, shortening a few breaks which was a little frustrating
None.
Some of the modules were overpacked, there was too much information to get through and not enough time.
Location. The rooms are hard to find, and are too crowded.
Staying in shared dorms with shared bathrooms
Frequently the hands-on sessions were a bit too long for the time allotted, and it causes some issue.

What respondents liked **least** about the GROWTH Astronomy School cont.

Response
when the notebooks were missing too much info - i.e. you couldn't make it work with the info introduced in the notebook
It felt like a lot of the lecturers and leaders for the hands-on modules did not scope their lessons to the group of students in attendance. Many of the hands on sessions contained a lot of code that we hadn't seen before and the instructors were moving way too fast.
the coding was either super easy or so challenging that you couldn't even get to the science theme of the programming modules. maybe in the future the programming modules can focus better on working toward the science goals and not just leave coding task for the users to struggle with for the sake of it being a class.
Please provide accommodation for the last day of the school. Please consider that the participants travel from different countries.
The room should have been more accessible for people with disabilities. Lots of people had difficulty walking over the many wires.
Some of the modules were not properly vetted - causing errors and slowing the pace of the activity. Also the balance of difficulty needs some work; sometimes the activities had little to 'do' (mostly filled out) and sometimes they were too open ended (entire chunks of code missing for us to fill out in a few minutes).
I thought the program could be made more effective with breakout sessions throughout the days - maybe for one session we work in small groups, or maybe we have group projects we work on throughout the 3 days that apply the lessons learned.
The short duration of the lectures, were a bit of information, and the short time for rest
I thought that many of the lectures were too short.
I think that we could've cut a few hands-on modules and taken a bit more breaks. At times it became a bit hard focusing on certain topics since I couldn't process that much from the previous modules.
a few particular modules that could have been structured better (machine learning)
Not enough time for some hand on exercises
What I liked the least was the super-condensed day after the excursion to La Laguna.
Perhaps a module on planets in order to complete the set of Astronomy topics.
I was somewhat frustrated when the tools would not work and I fell behind the class and/or could not complete the exercise. I appreciate we will receive the solutions.
Difficulty of some sessions, length of the school (could have been longer, 5 days)

What respondents liked **least** about the GROWTH Astronomy School cont.

Response
The workspace was conjusted and not sufficient. There were not enough interactive activities. Ipython notebooks are great to see things in action but not effective in actually gaining a practical understanding of the code, in my opinion.
it may have been outside of the host's control, but this campus has a lot of nice buildings and spacious rooms. why pick the oldest building, in a very crowded room with no AC to run the program?
TA's were really helpful however at the times they were not helping they were working on their own projects or sending emails, which was very distracting.
I wish that the school was a little longer (a few more days) so that we could spend more time focusing on important skills like calibrating spectroscopy, machine learning, etc. Some of the modules seemed really interesting, but we didn't have enough time to get through all of them. I think spreading out the 12 sessions over more days would be a good idea.

Respondents' likeliness to recommend the GROWTH Astronomy School

Value	Percent	Count
Somewhat likely	9%	4
Very likely	41%	18
Extremely likely	50%	22
Totals		44

Note: Response options included not at all likely, slightly likely, somewhat likely, very likely, extremely likely.

Respondents' suggestions to improve the GROWTH Astronomy School

Response
N/A
I think if we broke out into smaller groups during the hands-on session that would be much more helpful. A lot of times I would be falling behind and in a large group it's difficult to hold up everyone else for a very specific issue/not understanding the content. If we were in smaller groups I think that would be easier to manage/mitigate.
To provide after the end of the school all the solutions of the exercises in every jupyter modules.
Provide a way to give solutions on the modules section by section, so no one falls behind when we move on, maybe by pasting sections of the code in slack as we move through the modules.
Student exercises which are instructive
beta test the modules more and have the exercises more difficult than just copying and pasting code but not too difficult where you get stuck.
Maybe a bigger room? hehe :)
Perhaps 5 days? (money and time permitting) or cut down material if its too rushed Double sessions for more advanced topics like machine learning.
More optional exercises for advanced students.A clear expectation of the level of programming knowledge required.
Expanding the length of the lectures, trying to delve at least a little more deeply into radio analysis, providing more uniformity across the notebook modules (some were not very helpful) in the approach (too much was left to the students, wasting time that could have been better utilized).
More careful planning with module timing, otherwise it was excellent.
This is not content wise, but more information about the housing situation would have been helpful. Not everyone knew what to expect from the dorms and were unprepared for shared showers/bedrooms/etc.
There were some modules where I was just writing up code for graphs and such instead of writing code that was scientifically interesting. I feel like I can always look up the syntax for how to set up graphs and tables, but I would have liked to have more exercises in actual science skills
Please notify future participants if they will have roommates and will be staying in dorms with communal restrooms. This was not communicated clearly and I was unprepared to have two roommates and need to shower in a communal restroom. People needed shower shoes and no one let us know!

Respondents' suggestions to improve the GROWTH Astronomy School cont.

Response
Some consistent leveling of the expectations for Python skills.
A bigger room with similar seating would be better.
most people were grad students, so the level was probably right for them. however, for an undergrad it may had been a little too hard
I actually really liked the program. I think the timing of modules and lectures was perfect, and the hands on activities, when balanced, were very helpful. I don't know if there is anything other than these small details that can improve the experience.
I would recommend a longer duration, more information in the lectures, and I hoped to learn more about supernovae :(you could give at least one lecture only about this kind of objects
Different seats, they were definitely painful during the hours of sitting. Likely not a possible change, depending on the next location.
Make it 5 days.
I request that the jupyter notebook workflow should be in one direction only. The tutors should avoid scrolling up and down several times. This severely distracts and left me lost. There were one or two sessions where notebooks needed going up and down again, which is not recommended. I also suggest that please give numbers to tasks in jupyter notebooks. Many notebooks are introducing new terminologies, which the participants are not familiar with. It was easy to get lost which step is being followed. Tutor should give instructions that we are not completing task 2, and now moving to task 3. I think, this way it will be easier for participants to keep track.
Simplify the exercises for spectroscopy and radio
Focus a bit more on how to observe and trigger events.
Making sure that the modules are appropriately organized and that they have a strict focus. With some of the modules, we spent far too much time working on plotting/creating dictionaries and not enough time on the meat of the problem.
Some of the morning and night activities didn't leave much time to eat those meals. So making sure there is enough time to get to the dinning hall would be helpful for future schools. Overall, I think the days were well planned and the breaks/sessions were a good length.
Fruit or some healthy options during the breaks would be nice!

Session 1 [9:15 am]: Overview of Time Domain Astronomy

Respondents' perceptions of session usefulness in advancing research skills

	Not at all useful		Not very useful		Somewhat useful		Very useful		Extremely useful		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Mansi Kasliwal)	0	%	1	2%	12	27%	10	23%	20	45%	1	2%	44

Respondents' perceptions of session quality

	Low quality		Medium quality		High quality		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Mansi Kasliwal)	0	%	1	2%	42	95%	1	2%	44

Note: Darker shades of blue indicate higher counts of respondents who selected that rating.

Respondent's suggestion for improvement of the session

Response
The lecture wasn't meant to advance our research skills, I don't think, more than it was to introduce and motivate the following few days. and in that respect I think it was very successful!

Note: Respondents were shown this question if they rated the Overview of Time Domain Astronomy lecture as not at all useful, not very useful, or low quality. Respondents were not required to answer.

Session 2 [10:00 am]: Image Data Reduction

Respondents' perceptions of session usefulness in advancing research skills

	Not at all useful		Not very useful		Somewhat useful		Very useful		Extremely useful		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Dan Perley)	0	%	0	%	1	2%	13	30%	29	66%	1	2%	44
Hands-on activity with Jupyter notebook (Session lead: Dan Perley)	0	%	0	%	2	5%	11	25%	30	68%	1	2%	44

Respondents' perceptions of session quality

	Low quality		Medium quality		High quality		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Dan Perley)	0	%	0	%	43	98%	1	2%	44
Hands-on activity with Jupyter notebook (Session lead: Dan Perley)	0	%	0	%	43	98%	1	2%	44

Note: Darker shades of blue indicate higher counts of respondents who selected that rating.

Respondents' suggestions for improvement of the session

Note: This question was not shown because no respondents rated the Image Data Reduction lecture or hands-on activity as not at all useful, not very useful, or low quality.

Session 3 [1:00 pm]: UV/Optical/IR Photometry

Respondents' perceptions of session usefulness in advancing research skills

	Not at all useful		Not very useful		Somewhat useful		Very useful		Extremely useful		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Chris Copperwheat)	0	%	0	%	5	11%	15	34%	23	52%	1	2%	44
Hands-on activity with Jupyter notebook (Session lead: Kishalay De)	0	%	0	%	5	11%	17	39%	21	48%	1	2%	44

Respondents' perceptions of session quality

	Low quality		Medium quality		High quality		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Chris Copperwheat)	0	%	7	16%	36	82%	1	2%	44
Hands-on activity with Jupyter notebook (Session lead: Kishalay De)	0	%	2	5%	41	93%	1	2%	44

Note: Darker shades of blue indicate higher counts of respondents who selected that rating.

Respondents' suggestions for improvement of the session

Note: This question was not shown because no respondents rated the UV/Optical/IR Photometry lecture or hands-on activity as not at all useful, not very useful, or low quality.

Session 4 [3:30 pm]: Observing Run Preparation

Respondents' perceptions of session usefulness in advancing research skills

	Not at all useful		Not very useful		Somewhat useful		Very useful		Extremely useful		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Robert Quimby)	0	%	1	2%	6	14%	13	30%	24	55%	0	%	44
Hands-on activity with Jupyter notebook (Session lead: Robert Quimby)	0	%	0	%	9	20%	10	23%	25	57%	0	%	44

Respondents' perceptions of session quality

	Low quality		Medium quality		High quality		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Robert Quimby)	0	%	0	%	44	100%	0	%	44
Hands-on activity with Jupyter notebook (Session lead: Robert Quimby)	1	2%	1	2%	42	95%	0	%	44

Note: Darker shades of blue indicate higher counts of respondents who selected that rating.

Respondents' suggestions for improvement of the session

Note: Respondents were shown this question if they rated the Observing Run Preparation lecture or hands-on activity as not at all useful, not very useful, or low quality. Respondents were not required to answer and no respondents chose to respond.

[6:30 pm]: Observations using Mt. Laguna Observatory

Respondents' perceptions of session usefulness in advancing research skills

	Not at all useful		Not very useful		Somewhat useful		Very useful		Extremely useful		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Observations using Mt Laguna Observatory	1	2%	8	18%	9	20%	8	18%	11	25%	7	16%	44

Respondents' perceptions of session quality

	Low quality		Medium quality		High quality		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Observations using Mt Laguna Observatory	1	2%	9	20%	26	59%	8	18%	44

Note: Darker shades of blue indicate higher counts of respondents who selected that rating.

Respondents' suggestion for improvement of the Observations using Mt Laguna Observatory session

Response

Spending more time on each session and maybe spreading out over more days.

With better weather

Open other telescopes :) and less cloudy

Better weather next time :-)

This was awesome, favorite part. Maybe leave earlier and have dinner catered in the same location as lunch instead of having a 1.5 hour break between the end of the day and the trip.

If we could work on the observations from MLO, like reduce an image we took, that would be very fun and exciting.

It is difficult to determine what would have made this session more useful, because weather is not something we can control. If the weather had been better I think it would have been more interesting/helpful. But I did enjoy seeing the observatory!

Can't predict the weather...

Much of our time at Mt Laguna was spent standing around without it being clear what observations were being done.

If the clouds had gone away.

I think there was a large group and it's hard to show 20 people how observations on a telescope are done. So, as far a trip to the observatory, it was pretty fun but I don't think I learned any observing skills from the trip

Really enjoyed it - not super pertinent to me, as I've done many observations myself already

I did not attend because of the scheduling. We were not set to return to campus until 11:30pm and the following morning our sessions started 30 minutes earlier than the first day.

I don't think the purpose of the session was useful in advancing research skills. It was a high quality session that was useful in socialising with other students and was an overall positive experience.

You can't change the weather!

It was simply a bit cloudy so we couldn't do as much

To provide the solutions of exercise later the end of the school

Note: This item was shown to all participants, regardless of how they rated the Observations using Mt Laguna Observatory lecture or hands-on activity. Respondents were shown this question due to an issue with the survey platform.

Respondents' suggestion for improvement of the Observations using Mt Laguna Observatory session cont.

Response
Better weather :P
I don't think that the goal of the trip was to advance anyone's research skills.
A dedicated night of observing would have allowed for useful data to be obtained that could have been reduced later during the school. There was little planning of actual observations.

Note: This item was shown to all participants, regardless of how they rated the Observations using Mt Laguna Observatory lecture or hands-on activity. Respondents were shown this question due to an issue with the survey platform.

Session 5 [8:30 am]: Image Subtraction

Respondents' perceptions of session usefulness in advancing research skills

	Not at all useful		Not very useful		Somewhat useful		Very useful		Extremely useful		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Christoffer Fremling)	1	2%	0	%	4	9%	11	25%	27	61%	1	2%	44
Hands-on activity with Jupyter notebook (Session lead: Igor Andreoni)	1	2%	1	2%	2	5%	13	30%	26	59%	1	2%	44

Respondents' perceptions of session quality

	Low quality		Medium quality		High quality		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Christoffer Fremling)	1	2%	4	9%	38	86%	1	2%	44
Hands-on activity with Jupyter notebook (Session lead: Igor Andreoni)	1	2%	4	9%	38	86%	1	2%	44

Note: Darker shades of blue indicate higher counts of respondents who selected that rating.

Respondents' suggestions for improvement of the Image Subtraction session

Note: Respondents were shown this question if they rated the Image Subtraction lecture or hands-on activity as not at all useful, not very useful, or low quality. Respondents were not required to answer and no respondents chose to respond.

Session 6 [11:00 am]: Gravitational Wave Localization & Galaxy Crossmatch

Respondents' perceptions of session usefulness in advancing research skills

	Not at all useful		Not very useful		Somewhat useful		Very useful		Extremely useful		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Leo Singer)	0	%	0	%	12	27%	11	25%	21	48%	0	%	44
Hands-on activity with Jupyter notebook (Session lead: Dave Cook)	0	%	3	7%	12	27%	13	30%	16	36%	0	%	44

Respondents' perceptions of session quality

	Low quality		Medium quality		High quality		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Leo Singer)	0	%	7	16%	37	84%	0	%	44
Hands-on activity with Jupyter notebook (Session lead: Dave Cook)	3	7%	16	36%	25	57%	0	%	44

Note: Darker shades of blue indicate higher counts of respondents who selected that rating.

Respondents' suggestions for improvement of the session

Note: Respondents were shown this question if they rated the Gravitational Wave Localization & Galaxy Crossmatch lecture or hands-on activity as not at all useful, not very useful, or low quality. Respondents were not required to answer and no respondents chose to respond.

Session 7 [1:30 pm]: Machine Learning

Respondents' perceptions of session usefulness in advancing research skills

	Not at all useful		Not very useful		Somewhat useful		Very useful		Extremely useful		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Ashish Mahabal)	2	5%	9	20%	13	30%	9	20%	10	23%	1	2%	44
Hands-on activity with Jupyter notebook (Session lead: Ashish Mahabal)	2	5%	10	23%	13	30%	9	20%	9	20%	1	2%	44

Respondents' perceptions of session quality

	Low quality		Medium quality		High quality		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Ashish Mahabal)	9	20%	17	39%	17	39%	1	2%	44
Hands-on activity with Jupyter notebook (Session lead: Ashish Mahabal)	17	39%	13	30%	13	30%	1	2%	44

Note: Darker shades of blue indicate higher counts of respondents who selected that rating.

Respondents' suggestions for improvement of the Machine Learning session

Response
The exercises should involve machine learning, not struggling with dictionaries.
The entire class got stuck on making a dictionary so we never even got to actually training or running a machine learning related piece of program code.
The expectation of our baseline knowledge of the subject and ability to code it was too high. Additionally, the jupyter notebook wasn't well/clearly set up.
I found this module to be quite full-on and unclear with instructions as to where things were headed in the notebook session. The lecture beforehand was convoluted and seemed to cram too much vital information which was hard to follow. If this was refined to be more basic and to the point, it could be significantly improved.
There was a lot of code we were expected to write, covering a lot of advanced topics that people with no prior knowledge in machine learning (such as myself) really struggled with. I think more guided exercises that are less intense would be good
There was way too much time spent on menial things like reading in data that was not pertinent to the main topic of machine learning. The level of the notebook did not seem appropriate.
The lack of structure in this one made it fairly challenging to follow, and I didn't get a good idea of the big picture going into the lesson.
I think that the lecture was very dense and hard to parse. For someone with no prior machine learning experience it was very difficult to understand. The Jupyter notebook also did not have very clear instructions/explanations, or perhaps not enough explanation.
It was much too dense and the exercises were vague.
I already had a strong understanding of the topics that were discussed. This would still have been very useful for less experienced students
The lecturer I think assumed that we had more prior knowledge about the subject than we did. I would have preferred more of a deep dive into a specific type of machine learning and had the hands on activity be a bit more hands on than just clicking through
If there were more exercises throughout the coding session instead of just at the end.
The topic was presented at a level too complex for the amount of time we had, and the hands on session assumed we would be capable of a lot.

Note: Respondents were shown this question if they rated the Machine Learning lecture or hands-on activity as not at all useful, not very useful, or low quality. Respondents were not required to answer.

Session 8 [3:30 pm]: Spectroscopy

Respondents' perceptions of session usefulness in advancing research skills

	Not at all useful		Not very useful		Somewhat useful		Very useful		Extremely useful		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Robert Quimby)	0	%	1	2%	3	7%	13	30%	26	59%	1	2%	44
Hands-on activity with Jupyter notebook (Session lead: Matt Hankins)	0	%	1	2%	6	14%	11	25%	25	57%	1	2%	44

Respondents' perceptions of session quality

	Low quality		Medium quality		High quality		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Robert Quimby)	0	%	1	2%	42	95%	1	2%	44
Hands-on activity with Jupyter notebook (Session lead: Matt Hankins)	0	%	6	14%	37	84%	1	2%	44

Note: Darker shades of blue indicate higher counts of respondents who selected that rating.

Respondents' suggestions for improvement of the session

Note: Respondents were shown this question if they rated the Spectroscopy lecture or hands-on activity as not at all useful, not very useful, or low quality. Respondents were not required to answer and no respondents chose to respond.

Session 9 [9:00 am]: Lightcurve Analysis

Respondents' perceptions of session usefulness in advancing research skills

	Not at all useful		Not very useful		Somewhat useful		Very useful		Extremely useful		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Melissa Hayes-Gehrke)	0	%	2	5%	7	16%	10	23%	25	57%	0	%	44
Hands-on activity with Jupyter notebook (Session lead: Melissa Hayes-Gehrke)	0	%	1	2%	5	11%	13	30%	25	57%	0	%	44

Respondents' perceptions of session quality

	Low quality		Medium quality		High quality		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Melissa Hayes-Gehrke)	0	%	1	2%	43	98%	0	%	44
Hands-on activity with Jupyter notebook (Session lead: Melissa Hayes-Gehrke)	0	%	4	9%	40	91%	0	%	44

Note: Darker shades of blue indicate higher counts of respondents who selected that rating.

Respondent's suggestion for improvement of the session

Response

I already had a strong understanding of the topic

Note: Respondents were shown this question if they rated the Lightcurve Analysis lecture or hands-on activity as not at all useful, not very useful, or low quality. Respondents were not required to answer.

Session 10 [11:00 am]: Asteroids

Respondents' perceptions of session usefulness in advancing research skills

	Not at all useful		Not very useful		Somewhat useful		Very useful		Extremely useful		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Quan-Zhi Ye)	0	%	8	18%	11	25%	9	20%	16	36%	0	%	44
Hands-on activity with Jupyter notebook (Session lead: Dmitri Duev)	0	%	8	18%	11	25%	11	25%	12	27%	2	5%	44

Respondents' perceptions of session quality

	Low quality		Medium quality		High quality		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Quan-Zhi Ye)	0	%	8	18%	36	82%	0	%	44
Hands-on activity with Jupyter notebook (Session lead: Dmitri Duev)	1	2%	14	32%	27	61%	2	5%	44

Note: Darker shades of blue indicate higher counts of respondents who selected that rating.

Respondents' suggestions for improvement of the Asteroids session

Response
It's just not my particular field of research
Not a topic I am very interested in.
This session was just not pertinent to me and my research, but perhaps it was useful/interesting for other people. I did not think that the jupyter notebook had enough explanation for someone who had never used the tools before.
The things discussed were generally not of use for radio astronomers, and only an edge case for optical observers. This would still have been useful for more optical-focused students.
Asteroids are outside of my research area. I do think that this module would have been useful for someone who works with them.

Note: Respondents were shown this question if they rated the Asteroids lecture or hands-on activity as not at all useful, not very useful, or low quality.
Respondents were not required to answer.

Session 11 [1:30 pm]: X-ray Astronomy Data Analysis

Respondents' perceptions of session usefulness in advancing research skills

	Not at all useful		Not very useful		Somewhat useful		Very useful		Extremely useful		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Brad Cenko)	0	%	0	%	5	11%	13	30%	26	59%	0	%	44
Hands-on activity with Jupyter notebook (Session lead: Brad Cenko)	0	%	0	%	5	11%	18	41%	21	48%	0	%	44

Respondents' perceptions of session quality

	Low quality		Medium quality		High quality		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (Brad Cenko)	0	%	5	11%	39	89%	0	%	44
Hands-on activity with Jupyter notebook (Session lead: Brad Cenko)	0	%	6	14%	38	86%	0	%	44

Note: Darker shades of blue indicate higher counts of respondents who selected that rating.

Respondents' suggestions for improvement of the X-ray Astronomy Data Analysis session

Response
Providing the solutions of exercises later the end of the school
Not my area of research
towards the end it was very difficult to follow, but overall it was great material
They are great. Maybe try to standardize how the modules are structurized.
More time and more examples of how to use the data.
Have a longer session since this is a harder subject for most in my opinion
Slow down the activity or make easier
The lecture was a bit dry - some examples or a more open format would have been appreciated
I thought this session was fairly well.

Note: This item was shown to all participants, regardless of how they rated the X-ray Astronomy Data Analysis lecture or hands-on activity. Respondents were shown this question due to an issue with the survey platform.

Session 12 [3:30 pm]: Radio Analysis

Respondents' perceptions of session usefulness in advancing research skills

	Not at all useful		Not very useful		Somewhat useful		Very useful		Extremely useful		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (David Kaplan)	0	%	0	%	8	18%	15	34%	21	48%	0	%	44
Hands-on activity with Jupyter notebook (Session lead: David Kaplan)	0	%	3	7%	8	18%	15	34%	18	41%	0	%	44

Respondents' perceptions of session quality

	Low quality		Medium quality		High quality		Did not attend		Responses
	Count	Row %	Count	Row %	Count	Row %	Count	Row %	Count
Lecture (David Kaplan)	0	%	7	16%	37	84%	0	%	44
Hands-on activity with Jupyter notebook (Session lead: David Kaplan)	1	2%	14	32%	29	66%	0	%	44

Note: Darker shades of blue indicate higher counts of respondents who selected that rating.

Respondent's suggestion for improvement of the Radio Analysis session

Response

The jupyter session for this module was not well scoped at all. We just ended up copying his code from the screen. The things we needed to fill in the blank were gaps in specific plotting code - this wasn't very instructive to complete. I know that I can make a plot like that if given the time, but it was more challenging to complete someone else's code and I don't feel like it really taught me anything about radio astronomy.

Note: Respondents were shown this question if they rated the Radio Analysis lecture or hands-on activity as not at all useful, not very useful, or low quality. Respondents were not required to answer.

Demographics

Gender		Percent	Count
Male		50%	22
Female		48%	21
Other, please specify:		2%	1

Other, please specify:	Count
Trans + Male	1
Totals	44

Note. Response options were: Male; Female; Other, please specify; Prefer not to answer.

Race/Ethnicity		Percent	Count
Asian		32%	14
Hispanic or Latino		14%	6
White/Caucasian		50%	22
Other, please specify:		5%	2

Other, please specify:	Count
Biracial (white/asian)	1
Mixed	1
Totals	44

Note. Response options were: Asian; American Indian/Alaskan Native; Black/African American; Native Hawaiian/Pacific Islander; Hispanic or Latino; White/Caucasian; Multiracial; Other, please specify; Prefer not to answer.

Demographics

First-generation student status		Percent	Count
Yes		25%	11
No		68%	30
Prefer not to answer		7%	3
Totals			44

Note. Response options were: Yes; No; Prefer not to answer.

Key findings:

- 85% - 100% of the total 44 respondents agreed or strongly agreed that the Astronomy School influenced their skills and abilities. All respondents agreed or strongly agreed that the Astronomy School increased their knowledge of new tools that will enable them to achieve their research goals. This included Python, PSFEx, and data reduction/analysis techniques.

- 89% of respondents rated the level of content presented as just right. 9% thought it was too difficult and 2% thought it was too easy.

- Just over half, 55%, of respondents indicated that they really appreciated the multiwavelength observational technique, elaborating that being exposed to multiple wavelength observational techniques provided a broad scope of information that was useful for generating new research ideas as well as an understanding of multiwavelength astronomy.

- In general, the Astronomy School sessions received positive ratings in usefulness and quality across all sessions.
  - In contrast, observations using Mt Laguna Observatory received mixed reviews for the session's usefulness in advancing research skills. However, the majority of respondents still rated the session as high quality (59%) or medium quality (20%). Suggestions to improve the session largely indicated that the weather was bad, but respondents enjoyed the experience.
  - Machine Learning also received mixed reviews for the session's usefulness in advancing research skills and session quality. 39% of respondents rated the hands-on activity as low quality and 20% rated the lecture as low quality. The majority of respondents reported that the material was too dense and complex for students with no prior knowledge of machine learning.

- 91% of respondents were very or extremely likely to recommend the Astronomy School.

Recommendations:

- 20% of respondents disagreed that the hands-on sessions, overall, were an appropriate length for the content. If feasible, allow increased time for hands-on sessions that are content-heavy (e.g., Machine Learning). Or, reduce the amount of content provided during the lecture, if appropriate.

- To improve the perceived usefulness and quality of the Machine Learning session, consider providing an introduction to Machine Learning at the beginning of the session for students who have had no prior exposure to the topic. The instructor may provide online resources or handouts to students that help simplify concepts so that they may refer to them after the school has ended.

- A recurring theme under the least liked aspects of the Astronomy School was the length of time that the school was held given the amount of content presented. Improvements to this may include extending the length of the school to five days, simplifying the content presented in sessions to reduce overall time, and ensuring that lecture time does not spill into time allotted for the hands-on sessions.

- Respondents' recommendations to improve the GROWTH Astronomy School include providing solutions to exercises after the module has ended, having a bigger room with more comfortable seats, and providing information about housing situations ahead of time (e.g., communal restrooms). Instructors or Astronomy School coordinators can determine to what extent these are feasible to implement for the 2020 Astronomy School.