

The Value of Student Research: APUS Initiatives in Support of Online Education

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ABSTRACT

Online education offers students an affordable and flexible option but can be isolating. In order to provide a comparable experience to traditional schooling, online universities must give care to create both social and educational opportunities that will enhance the student experience and enrich classroom learning. As a fully online, asynchronous university, APUS is committed to providing quality education for its students. One of the most important enrichments provided by the APUS Space Studies department is its online student research groups. These provide students with the opportunity to develop relationships with peers and teachers; to gain experience analyzing astronomical datasets; and to contribute meaningfully to the Space Studies field. This paper summarizes best practices for involving students in faculty-led research endeavors in the online environment.

Keywords: online education, education, digital learning, STEM, Space Studies

El valor de la investigación estudiantil: iniciativas de la APUS en apoyo a la educación en línea

RESUMEN

La educación en línea ofrece a los estudiantes una opción asequible y flexible, pero puede resultar aislante. Para brindar una experiencia comparable a la educación tradicional, las universidades en línea deben priorizar la creación de oportunidades sociales y educativas que mejoren la experiencia estudiantil y enriquezcan el aprendizaje en el aula. Como universidad totalmente en línea y asincrónica, APUS se compromete a brindar una educación de

calidad a sus estudiantes. Uno de los enriquecimientos más importantes del departamento de Estudios Espaciales de APUS son sus grupos de investigación estudiantil en línea. Estos brindan a los estudiantes la oportunidad de desarrollar relaciones con compañeros y profesores, adquirir experiencia en el análisis de conjuntos de datos astronómicos y contribuir significativamente al campo de los Estudios Espaciales. Este documento resume las mejores prácticas para involucrar a los estudiantes en proyectos de investigación dirigidos por el profesorado en el entorno en línea.

Palabras clave: educación en línea, educación, aprendizaje digital, STEM, Estudios Espaciales

学生研究的价值：美国公立大学系统对网络教育的支持举措

摘要

线上教育为学生提供了一种可负担且灵活的选择，但可能会让人感到孤立。为了提供与传统学校教育相当的体验，网络大学必须注意创造社交和教育机会，以增强学生体验并丰富课堂学习。作为一所完全在线、异步的大学，美国公立大学系统 (APUS) 致力于为学生提供优质教育。APUS 空间研究系提供的最重要的充实内容之一是其线上学生研究小组。这些小组为学生提供了与同学和老师建立关系的机会；获得天文数据集分析的经验；并为空间研究领域作出有意义的贡献。本文总结了一系列最佳实践，用于在网络环境中让学生参与教师主导的研究工作。

关键词：网络教育，教育，数字学习，科学、技术、工程和数学教育，空间研究

Transcending Brick and Mortar Research

Online education is an increasingly popular modality, especially in higher education. Online education offers students an affordable and flexible option which

allows students and professors to interact in a virtual environment. This digital age has transformed the way in which we interact with one another and how we are able to learn and conduct research but can be isolating. In order to provide a comparable experience to traditional schooling, it is essential to

create both social and scientific opportunities that enhance the student experience and enrich classroom learning. The purpose of this panel is to highlight the research opportunities within the department as well as discuss particular challenges faced in the digital environment and how we can utilize our skills and technology to better serve the student body in robust and cutting-edge research.

Student Research in Online Education

Research is an important step in a student's academic career and being able to conduct research, especially in the space sciences, is monumental in preparing students for their professional goals. Providing opportunities to conduct research virtually distinguishes the American Public University System from other online programs. Virtual research opportunities foster a passion for knowledge in our students, and hands-on interaction with hard data help students develop the needed critical thinking skills for STEM disciplines. Not only do these individual research projects and research groups help with the specified discipline, but they also provide students with opportunities for professional growth, including participation in workshops and conferences, internships, and other ventures.

The Department of Space Studies at American Public University System (APUS) has a student population of 900 undergraduate and 350 graduate students enrolled in the respective

programs, so having multiple opportunities to conduct research is vital. The Department of Space Studies offers a number of opportunities for students to work on research projects within specified research areas whether they are one on one with a professor or part of a research group. These research areas range from astronomical observations of stars, supernovae, and exoplanets to modeling stellar systems with supercomputers to planetary geology including impact crater studies and geochemistry. With this diverse range of research being conducted within the department, students have a plethora of opportunities to become involved in one or more research projects which will suit their interests and needs for their future endeavors.

Exploring the Cosmos Through Faculty Research

Research Utilizing Supercomputers

To illustrate the diverse nature of the department and its faculty, Dr. Jeremy Wood, part-time faculty member, discussed his research which uses supercomputing to investigate the tidal interactions between white dwarf stars and asteroids in close proximity of these stars. Additionally, Dr. Wood highlighted how he uses Access, which allows researchers to use the supercomputers, to conduct work on studying Trojan asteroid capture. It is important to highlight that Dr. Wood has two students working with him on these projects since it shows how the department works to ensure students

are exposed to the different sides of space studies and can gain valuable experience with data driven research.

Diversity of the Planetary Science Research

As with many fields there are a number of niche categories which are researched, with space studies being no exception to this rule. While Dr. Wood's research focuses on the observational and modeling side of the field, others in the department focus on the planetary side with independent or collaborative research which has opportunities for student involvement. Dr. Ed Albin, Department Chair of Space Studies, discussed his previous research involving planetary geology and photo-geologic mapping of the Moon, Mars and asteroids. Dr. Albin also highlighted his current work with terrestrial impact craters and his current work with another faculty member in the department investigating the impact material from the Chesapeake Bay impact crater. This project involves analyzing the geochemistry and density of the tektites in Georgia and giving students at American Public University System the opportunity to be a part of this research.

To showcase the different avenues in planetary science, Dr. Michael Zeilinhofer, part time-faculty member, discussed his previous research involving impact craters on the dwarf planet Ceres and how analyzing particular features of the impact craters can help aid in the understanding of the composition of the object. Dr. Zeilinhofer continued the discussion by showcasing his

current venture of investigating impact crater shapes and interior features of the asteroid Vesta to learn more about the asteroid's formation and evolution. Since this work is ongoing, it is also a great opportunity for students to participate in part of the data gathering and analyzing process.

Student Driven Research Programs

The department also features two premier research groups which include the Supernova Research Group and the Exoplanet Research Group. Both of these programs utilize the American Public University System's Wallace E. Boston Observatory which houses a fully automated 24-inch CDK PlaneWave telescope. Unlike the faculty driven research where students can join in on parts of the project, these two groups allow students to learn the process of research and take charge through proposing project ideas and even mentoring other students. With this type of research model, it is important to highlight that we as professors need to focus not only on the group dynamic, but also the best practices to ensure the students are getting the most out of the programs and can utilize these skills for future research projects.

The Supernova Research Group

When it comes to student research it is important to highlight the interactions between student and teacher in both a traditional face-to-face setting and in the emerging online setting so we can assess the best practices and challeng-

es ahead. This is the most effective way to fully understand the changing learning environment in this growing digital age. Dr. Kristen Miller, advisor for the APUS Supernova Research Group, discussed the importance of having a research group which is inclusive to all students, regardless of their research background and skill level. Open participation research groups such as this can reach both students at the undergraduate and graduate level; they provide a valuable introduction to research practices and provide the fundamental skills needed for their research journey. An important value at the core of the Supernova Research Group is to be thoughtful and deliberate in the way the training is conducted to allow for the diverse student population, with varying backgrounds and skill sets, to come out of the process feeling as though they have contributed in a significant way to the research group. Dr. Miller detailed the importance of having robust training materials and the importance of student leadership in the research group. By having students teach students it brings another level to the process by not only giving the new students a non-intimidating way of understanding and learning the process, but also providing students with more experience and a chance to step into the mentor/leadership role which is vital for future success.

From the perspective of a former student, now part-faculty member and lead observatory assistant, Terry Trevino discussed the importance of the Supernova Research Group. He explained how when he joined, it was a

relatively small group, and how it has blossomed into the group it is today with active participation and continued growth. Dr. Miller expanded upon this by explaining how the format of the group, through Terry's help, became more of a team-based operation which has strengthened over time.

The Exoplanet Research Group

As a relatively new venture and branch off from the Supernova Research Group, the Exoplanet Research Group takes a different approach to how it operates. Dr. Katelyn Milliman, co-advisor of the Exoplanet Research Group, discussed the importance of this research group and how it came to be. Exoplanets are featured in the news often and students have a drive and passion to become involved in this exciting and relatively new field of study. With access to the Wallace E. Boston Observatory and the interest from the students, it became evident that an exoplanet research group was needed. This group has taken a different approach from the Supernova Research Group in the way it recruits members by having students first become active members in the Supernova Research Group to gain familiarity working with telescope images before applying to the Exoplanet Research Group, which involves more complex data analysis tools. Dr. Milliman also highlighted how this group takes the skills and knowledge from different members of the department including Dr. Miller, Dr. Zeilhofer and Terry Trevino to ensure the students are receiving the support they need during each step of the research project. When

it comes to best practices it is important to highlight how the professors need to transition the students from the rigid week-by-week format of classroom learning to a more open-ended, literature and research driven project. The Exoplanet Research Group accomplishes this transition by focusing on a “Team” format to ensure each member receives the most out of each part of the process. The group’s first Team has been together for the past nine months and is now helping to train the newly recruited second Team. As this group continues to work towards the goal of understanding exoplanets, they hope to expand the scope of the research well beyond the initial two teams.

Funding for Research

An important cornerstone of research is funding for these activities. At the American Public University System there is an opportunity for faculty to apply for faculty research grants to help support research projects with student involvement. The opportunity to gain funding through the university is key in continuing our venture of supporting students in the field of research. Dr. Miller showcased how the faculty research grants were able to help provide the Supernova Research Group with the tools needed to get started and become what it is today. While funding from the university is important to highlight, there are also other opportunities for faculty to receive external funding which can help support a wider group of students and build new research programs to foster learning.

The Algae and Plant Study

Just as the Exoplanet Research Group branched off from the Supernova Research Group, the Algae and Plant Study also branched off from the Supernova Research Group based on student interest. Algae is an important aspect for future space exploration, so having the opportunity to be a part of what humans will need for the future, when the time comes to travel to the Moon or Mars, excites and interests the student populace. Dr. Miller and Terry Trevino worked diligently to bring in outside consultants to ensure this project could coalesce to one focused project which could be submitted for external funding. The group did receive a \$100,000 NASA EPSCoR R3 grant through the West Virginia Space Grant Consortium; this funding was used to support the research efforts by providing the materials and facility access needed to complete the study. Thus far, the research has been promising with more tests and studies underway. Since the study began, the group was able to have 40-50 students participate with the hopes for even more engagement in the future.

Research Challenges and Solutions in the Virtual Environment

As with any type of education and research, there are specific obstacles and challenges which professors and students will need to navigate. Since the American Public University System serves as an online institution, it faces unique challenges

beyond those common in traditional university communities. It is important to highlight and recognize these challenges and the work needed to overcome them. Dr. Zeilnhofer presented the challenge of time. Because of the online nature of the school, students participating in these research groups reside in different time zones, so being able to set specific meeting times can be challenging. However, with all the forms of virtual communication our technological society has developed, such as email and the messaging services, students and professors can still communicate with each other on research projects without the need for constant face-to-face interaction. Dr. Miller and Dr. Wood continued this conversation by discussing the importance of having resources and documents in cloud-based services to allow students to work on research projects collaboratively without feeling overwhelmed by not being able to make a specific time for a meeting.

Another major hurdle for the virtual research environment, and online education as a whole, is retention. When students are not physically present in the classroom or within the research meeting, they may feel a lack of connection with their peers and their professors. Dr. Miller described how the Supernova Research Group addresses the retention of students through the cultivation of a sense of community; this is accomplished virtually through holding an “All Hands Meeting” once a month and through continual daily engagement, both conversational and research-focused, within the group’s Slack

channel. The Slack channel is also utilized in the Exoplanet Research Group for constant communication between the research advisors and the teams while they are pursuing different stages of the research.

Another hurdle in online research is the ability to communicate with students to guide them remotely through the data analysis process. It is important to help students both gain a foundational knowledge of research methods and also to learn the specifics in each discipline and how to go about proper data analysis. Dr. Wood described how this is a challenge since the professors are not in the room with the students while they are conducting the data analysis. To ensure the students are able to receive the best quality of education, it is important for the professors to sit down and highlight the process of data analysis and to develop clear templates and guidelines which can help students to fully understand the data they are analyzing. Dr. Wood also highlighted the importance of having the professors, and students, keep up to date with the latest software in their disciplines as it makes for a more streamlined process in data analysis and ensures the students are familiar with current practices; this is especially important for those students who plan to continue to pursue astronomical research upon graduating.

Another important aspect of research is identifying the best tools and resources, including papers and programs, to use. As society has entered a digital age, there is an overwhelming

amount of information and resources available; however, not all of these are suitable for the robust research being conducted at this level of education. Dr. Milliman stressed the importance of having the research advisors bridge the gap between what would be suitable for the specific project or discipline and what would be needed for the overall field. It is also important for us, as educators, to remember that the students are new to this process, and we need to support the students in navigating these tools and resources at each stage of the research project. In this way, the students feel supported and gain proficiency as future researchers.

Looking to the Future

As society continues its quest to develop new and cutting-edge technologies, it is important to take a step back and consider how this will affect education as a whole, including what role(s) this technology will play in the grander scheme of higher education. An important tool which has become available to society is AI. AI has become both a challenge and a

resource in education and it is important that educators understand these hurdles and use and learn to strike a balance between the two. Dr. Miller and Dr. Milliman both expressed their views on how AI can help with the lower-level thinking and processes in a research project while we need to continue to fan the flames of creativity and wonder to ensure the higher critical thinking skills can remain intact. To do so, professors and researchers need to have an open line of communication with students and foster an environment where the students can be free to explore topics that interest them and engage them as they continue this research. By providing the students with the basics and core principles of research methods, we can help build the core foundation to continue to nurture human curiosity. While technology will always push forward it is education and foundational knowledge which are at the root of all research. As the Department of Space Studies continues to grow and adapt to this ever-changing environment, one thing is always certain: education and research will always be the final frontier.