Who Are The Planetarians? A Demographic Survey Of Planetarium - Based Astronomy Educators

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ABSTRACT

Over the last 100 years since the planetarium was invented and began to spread across the planet, discipline-based planetarium education researchers have worked diligently to catalog what concepts are taught in the planetarium and what audiences learn when attending a planetarium show. What is not clearly known is precisely 'who' it is that are teaching astronomy in planetaria. Numerous small-scale studies give hints about who plantarians are, but the existing participant demographics provided shed precious little insight about them as broad field of professional experts. Knowing "who planetarians are" is critical to education researchers who need to know when they are studying planetarium educators who are more or less typical of most people in the field and when, instead, they are studying people who are unusual outliers and far less representative of the broader population. As a first step toward obtaining a glimpse of who planetarium educators are, a brief survey was broadly distributed through contemporary social media networks frequented by planetarium educators posing the question, "who are you?" The results from 61 respondents showed that 90% had undergraduate degrees, half of which were in physics or astronomy, and 38% hold graduate degrees. Additionally, only 8% have amateur astronomy or hobbyist backgrounds or any substantive K-12 classroom teaching experience. Perhaps unique to planetarium-based astronomy educators, 38% report having extensive backgrounds in theater and performance, These findings suggest that planetarium educators are a fundamentally different sort of individual than those who teach K-12 astronomy or do outreach as an amateur astronomer and, as such, perhaps have very different professional development requirements and expectations from those other astronomy-education related professional development consumers.

Keywords: Discipline-Based Astronomy Education Research; Planetarium Education; Educator Demographics

From humble beginnings starting from zero less than 100 years ago, planetariums today exist all over the world. Many planetariums exist in K-12 school buildings or university buildings as part of a larger formal education campus. Others exist within museums or science centers. Some planetariums stand alone as their own entity. And in recent years, thousands of planetariums in service today are portable, and travel by automobile from school to school.

In 1994, Jim Manning did the exhaustive investigative work by dissecting the planetarium directory of the *International Planetarium Society* to categorize where planetariums were located. He found that about 33% of planetariums are located in K-12 school district run buildings, 17% are on college and university campuses, 15% are part of museums and science centers, 7% are associated with astronomical observatories or other institutions and about 27% have unclear associations, such as perhaps being standalone facilities or evenly distributed among the other categories. He further reported that about half of the world's planetariums are in North America. Jumping ahead two decades, we do not see dramatic changes in the numbers. When considering domes that are full-dome video capable - that it, those with computer projection systems instead of only having conventional mechanical star balls - Petersen (2019) reports similar numbers that 31% are in school districts, 33% are on college and university campuses, and 26% are part of museums and science centers.

What has changed considerably is how many planetariums there are and how many people are attending planetariums worldwide - both values have increased considerably. For the past 25 years, Petersen (2020) has been keeping close

tabs on annual planetarium attendance. Whereas Manning (1996) conservatively estimated that about 2,000 planetariums were in existence in 1994, Petersen reports that number to have doubled in 25 years to at least 4,267 working planetariums in 2020. The number of brick-and-mortar planetariums in the US increased slightly, but construction has dramatically increased in other countries. More influentially, the number of portable planetariums has increased exponentially as acquisition costs of computer-based video projection have come down considerably. Perhaps even more interesting is that Petersen reports the growth in planetarium attendance to have doubled to a 2020 value of 142,613,107 per year worldwide. Planetarium attendance is definitely popular, as this number is on par with the total number of people who attend professional sporting events put on by the five major sports leagues (MLB, NFL, NHL, NBA, MLS).

Contemporaneously, discipline-based planetarium education researchers have carefully cataloged detailed information about who attends planetaria, and what concepts are taught with what frequency, what people learn, what captures audience's attention, what distracts from the learning process, and how teaching styles compare to that of conventional K-12 classrooms (Slater & Tatge, 2017). Numerous small-scale studies give hints about who planetarians are, but the existing participant demographics provided shed precious little insight into who planetarium educators are as a broad field of professional experts.

Knowing "who planetarians are" is critical to discipline-based astronomy and planetarium education researchers who need to know when they are studying planetarium educators which ones are more or less typical of most people in the field and when, instead, they are studying planetarium educators who are unusual outliers and far less representative of the broader population. Moreover, knowing who planetarians are provides valuable information to planetarium designers, planetarium program marketers, and professional development providers: Do planetarium educators know what a black hole is? Do planetarium educators need science content updates? Do planetarium educators have a "rubber meets the road" experienced knowledge of on what is going on in K-12 schools the service? In short, who are the planetarians?

LITERATURE BACKGROUND

Across the scholarly landscape, there exist very few astronomy educator demographic surveys published of any sort. Naturally, one might wonder if astronomy educators have any formal training in astronomy, or science at all for that matter. Before now, what little data existed about planetarium educators was gleaned from the participant demographics descriptions included in planetarium education research papers. Most notably, Plummer and Small (2013) interviewed 36 planetarium education (11 female and 25 male) about their goals for learning in the planetarium. Of her their participants, 56% had been in the planetarium field for more than 15 years. Twenty-eight percent worked at universities, 19% for K-12 school districts, 19% for museums, 10% for planetarium construction companies, and the remaining 17% as 'other,' such as consultants. In terms of formal degrees, 92% had an undergraduate degree, and about half of those held physics or astronomy undergraduate degrees. About a third held a master's degree of one sort or another. These results are similar to those reported by Manning (1994) two decades earlier. It is unknown how representative of the planetarium field at large these participant pools were, but if generalizable, one can surmise that planetarium educators are highly educated.

How else could one get a sense of who astronomy educators are? As there are no contemporary demographic surveys specific to planetarium educators in the scholarly literature, one could look to surveys of other types of astronomy educators. For one, while working alongside in-service teachers to develop a high school level astronomy curriculum, Sadler (1992) found that nearly all the high school teachers he worked with in the Greater Boston area obtained their astronomy expertise from a personally motivated, hobbyist perspective and rarely from any formal college-level astronomy coursework. Neary two decades later, Plummer and Zahn (2010) reported on a survey of 59 active astronomy teachers in the Greater Philadelphia area. While trying to understand what the enacted curriculum was in the domain of school-based K-12 astronomy astronomers, they found that the majority of teachers in their sample felt reasonably well prepared to teach astronomy and that most, but certainly not a substantial majority, had never had a college level astronomy courses.

About the same time, but casting a much wider net while trying to better understand the impact of widespread federal legislation about high quality teacher qualifications, Krumenaker's (2009) surveys of 300 active high school teachers

found that most had taken a college astronomy course and that 8% had undergraduate degrees in astronomy, but more than 15% of teachers in his national level sample had never taken even a single astronomy course. Curiously, at the time of Krumenaker's (2009) work, 13% of high school astronomy teachers reported having ready access to a planetarium as needed. Although astronomy coursework was far more prevalent among Krumenaker's (2009) study participants, it still wasn't close to 100%.

This is not to argue that having a college astronomy course is or is not sufficient training to be an astronomy educator, what these researchers are saying is that among high school astronomy teachers, a college astronomy class is not a commonly shared experience that one might naturally expect. Upon reflection, this doesn't seem that unusual at the K-12 level. This could be because, although at the university level, astronomy courses and astronomers themselves are most often associated with College Physics Departments, this is not the case for future K-12 teacher training responsibilities. At the K-12 level, astronomy is most closely associated with the Earth sciences division, not the physics division. This non-universal participation in formal college astronomy courses by teachers might be a reflection of a disconnect due to the responsibility of training Earth sciences and geology teachers by College Earth Sciences and Geology Departments, rather than by College Physics Departments where astronomy resides and who participate in training future physics teachers.

At the college teaching level, Fraknoi (2001) surveyed general introductory astronomy survey courses for non-science majors in the U.S. - commonly referred to as ASTRO101 - taught by college faculty at non-research intensive or extensive universities. His survey of 247 faculty were primarily regarding those who were teaching at community colleges, and who, by the way teach the majority of students who take an ASTRO101 course, including future teachers. He reported that 38% hold a Ph.D. of any kind and only about 1/5 of those were in astronomy. Instead, these college astronomy educators at often held degrees in physics, mathematics, geology, geography and learned most of their astronomy informally. In recent years, these numbers have perhaps changed somewhat as some state accreditation agencies ask that college instructors have at least 18 graduate semester hours in their discipline, but it is unclear how this requirement plays out in actual practice.

Another group of astronomy educator's worth considering is that of astronomy outreach enthusiasts. These are individuals most often, but not always, associated with amateur astronomy hobbyist groups. Berendsen (2005) conducted a massive survey of nearly 900 amateur astronomers who co-identified themselves as being involved in outreach to determine their level of astronomy knowledge. Not only did she find that amateur astronomers were highly knowledgeable, but she also reported that although 9% had an unspecified level of degree in astronomy, 57% had at least one college course in astronomy, 13% had only high school astronomy, and 30% had no formal coursework of any sort in astronomy. Berendsen (2005) further reported that the more frequently amateurs conducted outreach, the higher their scores were on the *Astronomy Diagnostics Test* ADTv2.0 (Hufnagel et al. 2000,). This is particularly poignant given that Slater (2014) found that when comparing scores on the widely used TOAST *Test Of Astronomy STandards*, that amateur astronomers often scored just as high professional research astronomy professors.

If high school astronomy teachers and college astronomy instructors and amateur astronomy outreach enthusiasts are so incredibly different in terms of their background and who they "are," then one is motivated to get some sense of who the astronomy educators who impact the largest number of people every year - planetarium educators - are? This is the overarching question driving this study.

METHODS & RESULTS

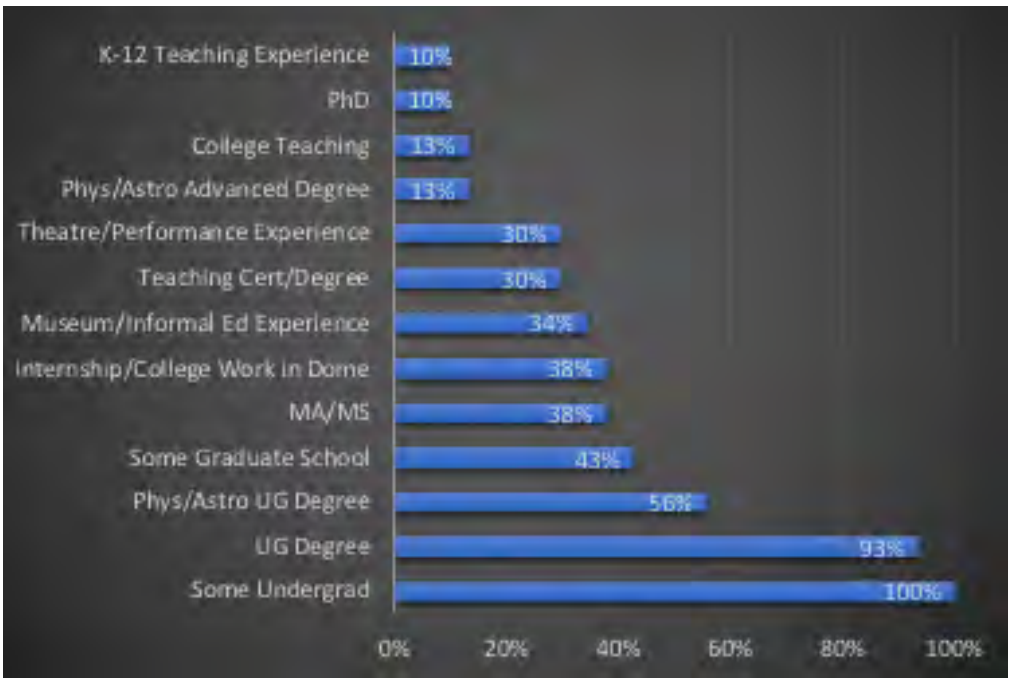
As a first step toward developing a profile of planetarium educators as a profession, a discussion held within the volunteer and open-access Facebook.com group "Dome Dialogues" about what backgrounds participating planetarians held. This online discussion group is comprised of planetarium professionals from around the globe. The purpose of "Dome Dialogues" is stated to be, "a place for members of the planetarium industry - both in the dome and out - to discuss the pressing matters that face our field. It is a place to share resources and best practices, and to support the incredible work being done in our community." The Dome Dialogues has a current membership of 954 users. These individuals are current and past planetarium professionals as well as student and volunteer staff in planetariums.

The primary analysis technique was to look for emergent themes in stated previous experiences of planetarium professionals posted in the group. Sixty-one members responded to the question. These individuals were self-selected, as they voluntarily posted a public answer to this question. These 61 respondents make up a about six percent of the group's membership, and a much smaller fraction of the entire planetarium professional field. Nonetheless, in the absence of other data, posted responses systematically analyzed for common themes. The emergent themes were then quantified. As such, although this study uses what appears to be qualitative data, converting the narrative data into observed frequencies that themes and statements appeared, the study is by its nature a quantitative study.

Not surprisingly, the participating members' responses describing their previous experiences were quite varied. However, there were several commonalities that repeatedly arose. The one characteristic that all respondents shared was some undergraduate college experience, nearly 100%. This was followed closely by the completion of an undergraduate degree, which 93% of respondents reported. These undergraduate degrees covered a wide range of content areas, but just over half (56%) were in a physics or astronomy related field. Forty-three percent of respondents reported having had some advanced degree experience, with 38% of them completing a master's degree, and 10% completing a doctorate. In addition, of these advanced degrees, 13% of them were completed in a physics or astronomy related field.

One might wonder to what extent these individuals come to the planetarium field with formal education backgrounds. Thirty-eight percent of the total number of participants reported having completed some level of teaching certification or education degree. About 10% of the respondents report having teaching experience in K-12 education, while 13% report having college teaching experience. For clarification, college teaching experience encompassed not only primary lecturer/professorship, but also teaching assistantship as experienced by most graduate students.

Figure 1. Planetarium Experience History



Informal education experience is another likely avenue for planetarium professionals to get their start. Thirty-four percent of participants reported experience in informal education through museums, nature centers, etc. Additionally, 38% reported having had experience in college or through an internship in a planetarium.

One theme that arose in the responses was a background in performance, which was unexpected though not surprising given the nature of planetarium work. The performance backgrounds of the participants ranged from professional musicians to various forms of theater. Of the participants, nearly one third (30%) reported previous experience as a performer of some kind.

DISCUSSION AND CONCLUSION

No one knows precisely how many planetarium educators exist worldwide, but given that the membership rolls of the premier planetarium professional association, the IPS International Planetarium Society number of members to be about 600 and the membership of the highly active and decades-old online electronic discussion listserv *DOME-L* number about 1,400, whereas the Dome Dialogues group on Facebook numbers less than 1000. We judge that receiving 61 responses to be a surprisingly sizable portion of the planetarium educator field as a whole, particularly as a first step. Unquestionably, a great degree of caution is warranted when making sweeping generalizations about precisely who this audience is given that there were no experimental sampling controls in who responded.

Although this work represents first-steps, quasi-experimental, snap-shot study with uncontrolled sample, the results of the particular survey show that, consistent with earlier work cited, this survey reveals, insofar as it can measure, that planetarians who are willing to participate in studies, surveys, and interviews can be characterized as universally having undergraduate degrees, with about half in the closely related scientific fields of physics and astronomy. Additionally, about 3/5 hold a graduate degree with 10% being a terminal degree.

On one hand, this study is another small sample glimpse into the much larger planetarium community. On the other hand, its results are consistent with those of earlier researchers. What is not known at all is what pathways planetarians followed to get into their career stream. A more formal approach to surveying the field with some specific sampling controls (Slater, Slater, Heyer, & Bailey, 2015, p. 67) is needed to get a better understanding of the previous experience of planetarium professionals and we call upon the community of discipline-based planetarium education researchers to pursue this work.

AUTHOR BIOGRAPHIES

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