This presentation reviews the research I did for my doctoral dissertation. My interest was in using the planetarium as a teaching tool in the best way possible. I wanted to be able to support and better serve my largest (paying) audience which is the k-12 school groups. I wanted those teachers who bring their students to my planetarium to see the visit as an extension of their classroom and a reinforcement of what they are doing in their classrooms. There is very little by way of research on best teaching practices in the planetarium, however, research abounds and has a rich history in teaching in classrooms. If I were to consider the planetarium just a “modified classroom” then could those well-researched strategies which have proven to be effective in classrooms also work in the planetarium? Were they already present and we just don't know it?

Active learning is at the forefront of modern teaching pedagogy, so I wanted to start there. It has been shown to improve student learning and attitudes and lead to longer retention. This is especially the case when the students get timely feedback on their active learning through formative assessment. Formative assessment is assessment for not of learning. Contrasted with summative assessment (which many of us are more familiar with) in which the assessment is given at the end of the learning (e.g. exam, final paper, presentation, etc) is assessment as the students are learning. This type of assessment helps the teacher and student both gauge learning as it happens so steps can be taken to correct misunderstandings. Thinking about this in a planetarium environment, it is akin to letting the audience guide the presentation. But in this case we are letting them guide based on their understanding, not their preferences.

Beyond looking into what modern classrooms were doing, I wanted to consider a teaching method that would be the easiest to implement for planetarians. Many of us are constrained by a number of things (e.g. money, time, space, etc), myself included. So I wanted to look into something that would require little to no additional props or materials or technology. I considered what most of us already do in our planetarium
presentations and that is asking questions of our audiences. Strategic questioning is a strategy of formative assessment, which in turn, is a method employed in active learning. In this presentation, I speak of assessment conversations specifically, which is this strategic questioning approach.

Assessment conversations have a solid foundation in educational theory as you can see from Figure 1 - Theoretical Framework of Active Learning.

Assessment conversations are toward the top of this pyramid, with ESRU cycles being the topmost part. The ESRU Cycle, as developed by Ruiz-Primo & Furtak (2006) is a way to critically analyze these assessment conversations and determine to what level they reach. The ESRU cycle is illustrated below in Figure 2 - ESRU Cycle.
In this figure, you can see where the letters of the ESRU Cycle come from. E is for the Teacher *Elicits* a response (i.e. asks a question). S indicates the Student response to the question. R is for the teacher *Recognizing* the student response. And finally, U is for the teacher *Using* the response from the student to guide instruction. In their research with STEM classrooms, Ruiz-Primo and Furtak found that very few teachers actually completed the cycle by getting to the using stage without explicit training in that area. I was curious to find out if these assessment cycles were happening in the planetarium “classroom” or not and to what extent. Considering Ruiz-Primo & Furtak’s work, I did not expect to see much in terms of complete cycles present in planetarium presentations. With that in mind, I was also interested to see what factors might influence the relative presence or absence of complete ESRU cycles there in.

In order to accomplish this, I needed a two-fold approach. I first needed to get a feel for what is already happening in planetariums. I did this through requesting recordings of planetarium presentations from colleagues across the U.S. Additionally, I had participants fill out a brief questionnaire to give some insight to the facility and presenter demographics for each recording. Secondly, after listening to and coding these recorded presentations with the ESRU cycle, I went back and interviewed several of the participants to find out about the factors that might be influencing their level of complete ESRU use.

What I found after reviewing more than 660 questions contained in 26 hours of recordings was that there was generally very little complete ESRU cycles present. Clearly there were lots and lots of questions asked, but most fell short of the goal of Using those answers to guide the presentation and improve learning.
Additionally, when considering these findings and comparing them with the data from the questionnaires, there seemed to be no relationship between any of the demographic data and these findings. The data gathered and compared through the questionnaire are as follows:

- Presenter Gender
- Presenter Years of Experience
- Type of Show/Audience
- Show Length
- Dome Size/Capacity
- Dome Seating Arrangement
- Dome Projection System

None of these characteristics of either the facility, the presenter, or the show seemed to have any relationship with the level of complete ESRU cycles found.

With no clear reasoning behind what I was seeing from the recordings data, I moved on to the second stage of my research which was the semi-structured interviews. I wanted to speak with some of these participants at various levels of complete ESRU cycles to see if there were other factors that could be influencing them.
I interviewed 8 of the 26 participants, ranging across the spectrum of low to high complete ESRU cycles. After talking with them about their recording and their presentation styles/philosophy, I found four recurrent themes.

1. Presenters may not value active learning because their goal is to inspire, not teach
2. Interactivity and active learning techniques may be more of a classroom management tool than a teaching tool
3. Active learning takes many forms and presenters may not be aware of various kinds and uses
4. Presenters feel constrained by time (too much to cover, too little time) and limited training on active learning

Of these themes, the first one surprised me the most initially but made more sense in hindsight because taking on the burden of trying to teach all of astronomy to a group of students you see once for a brief amount of time can be too monumental. Though I posit that, through these ESRU cycles, we can try to achieve both.

Overall, there seems to be an opportunity here for planetarians to learn more about these assessment conversations, and more purposefully ask questions of their audiences to help improve and extend learning. We can take the interactivity we are already doing and fine-tune it a little to make it interactivity for better learning.

My goal in this research was to get an idea of what is happening in domes and see if there was a need (or desire) for professional development in this particular area of active learning. It seems to be a possibly valuable skill for planetarians to have if they would like to not only inspire, but also engage and teach better. My next step would be to work to develop this professional development opportunity. What form it may take is currently unknown, but there seems to be a desire for it. If you have ideas on what kinds of things you would want out of such an opportunity or are interested in one, please let me know. I am doing this for all of us and need your input! Go to the link below if you are interested in learning more or would like to hear about training opportunities!

https://forms.gle/rqn4wEq1VwYPnDhG8