Motivating a new genre for the fulldome era: Perspective from planetarium professionals

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Introduction

It has been approximately 10 years since the first permanent fulldome planetarium system was installed at Chicago's Adler Planetarium. Currently there are over 3000 planetarium facilities world-wide. By the end of 2010, projections estimate about 600 will have fulldome projection technology (Bruno, 2008). The planetarium field is in a state of evolution with more and more fulldome theaters being constructed and fulldome technology continuously replacing traditional theaters. In the last two years, the number of fulldome theaters worldwide has doubled (Petersen, 2009).

While utilizing the latest technologies is progressive and an appropriate direction for the field, the types of programs that are being created to show in fulldome theaters are similar in their presentation approach. These programs, which are often referred to as "fulldome movies", are largely push-button initiated with no built-in interaction with a live presenter. Therefore, the "for sale" program options for fulldome planetarium facilities are those that provide audiences with a completely passive experience. Given the difficulty, time and expense in creating a professional quality fulldome program, many planetariums are not able to produce their own high quality in-house fulldome programs. As a result, the current productions appear to be influencing the field towards increased emphasis on passive presentations. If this trend persists, the programming adopted by the world's planetariums may limit the experiences offered to audiences by excluding opportunities for active engagement.

Many professionals in the field feel a need to restore active educational experiences back into their facilities. In a study of leaders of the planetarium field, James Croft (2008) found that instead of focusing on entertainment as their primary goal, as might be expected if planetarium professionals favored passive fulldome "movies," planetarium professionals strive to educate their audiences and work to communicate complex scientific ideas using the planetarium medium. These beliefs are echoed in a recent article on planetarium professionals (Littman, 2009). "The function of a planetarium is to educate", says Dr. Ronald Kaitchuck, Ball State University. "That's not what movie theaters do. If planetariums try to become movie theaters, they're doomed". Dennis Schatz, Pacific Science Center, agrees; he thinks too many planetariums are trying to duplicate an IMAX thrill show on their domes. "They're losing connection to the night sky and the basics of astronomy". Kaitchuck continues to state, "A key part of the planetarium experience for young and old alike is contact with a live person who can answer questions and inspire. That makes it a personal experience." Planetarium professionals' emphasis on interaction is also reflected in their audiences' interests. Visitors to informal science

education venues want to have more interactive exhibits and programs, especially high-tech, multi-sensory simulations for both children and adults (Raphling & Keane-Timberlake, 1997).

Educational research (including studies conducted on planetarium learning experiences) indicates that active experiences for audiences are more effective in promoting the types of cognitive engagement that produce affective and cognitive changes (e.g. Bell, Lewenstein, Shouse, & Feder, 2009; Brazell & Espinoza, 2009; Donovan & Bransford, 2005). This is particularly true for children, as interaction will increase their focus and help make experiences less abstract. Different approaches to children's planetarium programs versus adult programming may exist because of the shorter attention spans and level of cognitive processing of younger audience members. However, these research findings seem to be at odds with some of the trends in current planetarium programming. Therefore, this study explores planetarium professionals' opinions on the design of learning environments for younger audiences and their views on providing educational experiences in the dome.

Planetariums can provide unique informal educational experiences to audiences but improving audience member's conceptual understanding of astronomy lies in the program implementation. Instruction must actively engage children in comparing their initial ideas to the scientific ideas in order to facilitate conceptual change (Bransford, Brown, & Cocking, 2000; Sinatra & Pintrich, 2003). This piece of active engagement is critical to either simple assimilation of a new but compatible idea, or a more extensive restructuring of existing ideas. In the 1970s, the planetarium community began to discuss how to actively engage the audience in 'participatory oriented programs' rather than the traditional lecture model (Friedman, Schatz, & Sneider, 1976):

> A very exciting alternative to a passive-audience program that relies on elaborate special effects is the "participatory oriented planetarium" (POP) programs now being used at more than a dozen smaller planetariums. In these audience participation programs the visitors are actively involved in: 1) discovery-approach activities; and 2) extensive verbal interactions with other audience members and the planetarium instructor… The most important distinguishing feature of a participatory oriented program is that the audience is actively involved in thinking about the subject matter, not passively absorbing audio-visual information. (p 4)

In 1982, Mallon and Bruce investigated the use of participatory oriented programs in small educational planetariums. Through a paper-and-pencil content test and a Likert-style science opinionnaire, they found that the participatory oriented program was more effective than a traditional "canned" program in teaching constellations, and possibly for improving students' attitudes towards astronomy. Bishop (1980) found that model manipulation and drawing in the planetarium can help students learn projective astronomy concepts (such as the day-night cycle and the phases of the moon). Sarrazine (2005) successfully supported middle school students' understanding of the phases of the moon using participatory oriented programming with a strong emphasis on multiple intelligences. Plummer (2009) published a study of a participatory planetarium program in which first and second grade students showed significant improvement in understanding of apparent celestial motion concepts. This improvement can be attributed to the use of kinesthetically and visually interactive live techniques in

the program. Beyond these studies, there has been little published research investigating the use and educational value of participatory planetarium programs nor the community's beliefs and interest in these types of programs.

Based on these investigations conducted in planetarium environments as well as the extensive literature on how people learn, we propose that fulldome technology could continue to engage audiences through *modular automated programs*. A modular fulldome automated program would be a pre-recorded program produced in short segments that each focus on one or maybe two main topics. The pre-recorded segments could be separated and complimented by live interactive segments. Live segments would call for a planetarium operator to interact with the audience through a variety of ways. These segments could be used to: explore audience members' prior conceptions, on-the-spot feedback of audience understanding, introduce topics in the automated segments, allow immediate discussion of topics presented in the short automated segments, and review topics in the automated segments. Based on literature, we suggest that this type of program design would keep the audience more engaged in their experience in the planetarium. Further, it would provide planetarium operators with more flexibility in presenting and audiences with more control of their learning while still utilizing the capabilities of fulldome technology.

The idea of creating more engaging experiences in informal science environments is not unique to the planetarium field. The NSF funded National Research Council's report, Learning Science in Informal Environments: People, Places, and Pursuits (Bell, Lewenstein, Shouse, & Feder, 2009) recommends that people who design programs in informal settings create programs and environments that are interactive and designed with specific learning goals in mind. Further, the report indicates that informal science education (ISE) programs should provide multiple ways for learners to be engaged and should offer learning opportunities designed to build on the learner's prior experiences.

Our review of the literature on planetariums and the state of the planetarium field suggests that there may be a gap between the nature of the current fulldome program design and planetarium professionals' beliefs. Further, while we believe that modular show design would support learning based on research in formal and informal environments, the limited literature on planetarium professionals' perspectives and practices makes us wonder whether or not the field would support this design. In this paper we explore four major questions to analyze aspects of the current state of the planetarium field and how the beliefs and opinions of the professionals in the field reflect this current state.

1) What are planetarium professionals' goals for audiences and beliefs about designing planetarium programs?
2) Does the current fulldome passive programming support planetarium professionals' goals and beliefs about planetarium education?
3) What additional goals and beliefs are held by professionals about planetarium education for elementary-aged children (grades K-4)?

4) Are planetarium professionals currently integrating live content with pre-recorded content? If so, how are they doing this?

Methodology

Interviews

Interviews were conducted at two annual meetings of regional planetarium associations as well as over the phone with conference attendees who did not have time to be interviewed onsite. In total, thirty-six planetarium professionals (25 male and 11 female) were interviewed (31 onsite; 5 by phone). This included vendors who may have worked at planetariums in the past as well as current planetarium directors and operators. Participants were not selected randomly; they either self-selected to be interviewed after hearing a short presentation given by the co-authors or were invited to be interviewed while they were in the vendor hall.

A semi-structured interview was used to allow participants to provide rich and detailed responses. The interview consisted of 12 questions covering: demographic information, goals for the planetarium, opinions about general show characteristics, live interaction in the planetarium, and their thoughts on adding live interaction to pre-recorded programming (Appendix A). Some questions dealt with broad perspectives on planetarium issues. Other questions dealt specifically with beliefs about children (grades K-4) visiting a planetarium. Two questions were only asked of the participants after the first set of conference interviews based on ideas that came up during the first set of interviews. In other cases, some participants were not asked questions that did not relate to their practice. For example, vendors and consultants who did not or had not worked as a planetarium operator were not asked specific questions about experiences related to delivering planetarium content to audiences. These interviews were conducted on a one-on-one basis by the first author. Interviews ranged in length from approximately 6 to 41 minutes. Interviews were audio-recorded for later analysis.

Analysis

A series of categories were developed based on the original questions. We developed a set of initial codes representing concepts we expected to see in the interview data. Then, both authors listened to a sub-set of four interviews to develop additional codes to describe concepts that appeared in the data. The remaining interviews were split, with each author coding 16 interviews. Periodically during this coding process, the authors met to compare coding and determine whether new codes should be added or old codes should be clarified. Each author then reviewed previously coded interviews to match any changes produced in discussions. Finally, eight interviews were selected to be coded by both authors (containing 4 interviews from each subset of 16 interviews). An inter-rater agreement of 96% was reached in this final comparison.

We recognize certain biases may arise from the design of our study. As participants were not randomly selected but instead volunteered to be interviewed, we may be biased towards practitioners who agree with our positions. This includes people who may believe that fulldome planetarium programs should

have live components. We attempted to reduce this bias through our description of the study and invitation to participate; when announcing our study we encouraged people of all perspectives to talk to us to get the full range of opinions in order to acquire a more balanced sample. Another potential bias in this study is that we only interviewed people who attend planetarium conferences. It is possible that the planetarium professionals who choose or are able to attend planetarium conferences represent a select group in terms of their beliefs and goals for the planetarium.

Findings

Demographics

The majority of participants (56%) have been in the planetarium field longer than 15 years. Participants were drawn from school districts (19%), universities (28%), museums and science centers (19%), planetarium vendors (11%) and other work situations (17%), with two unknown. A majority of the fixed planetarium theaters in the US are associated with an educational or cultural institution (Petersen, 2009). Thus, the interview participants were representative of the types of facilities housing planetariums. Table 1 reports the distribution of jobs held by the participants.

Table 1 – Reported Current Jobs of Participants

Current Jobs	**N=36**
Planetarium Director/Coordinator/Supervisor/Manager	19
Planetarium Operator/Presenter	5
Vendor	4
Planetarium Consultant	2
Unemployed/Retired	2
Education Specialist/Outreach for Government Agency	1
Other Management Positions	1
Planetarium Technician	1
Self-Employed	1

The participants in this survey reflect the growing trend towards fulldome technology and these results suggest fulldome technology will continue to increase in the near future. Slightly over half of the asked participants (53%; n=30) reported that they currently work with fulldome technology (six participants were not asked if they work with fulldome technology because of their current employment status). Four other participants reported that they hope to have fulldome technology in their facilities soon.

Goals for the Planetarium

Analysis of the interviews suggests that the planetarium community holds multiple goals for their audiences including: increasing knowledge of astronomical concepts, increasing interest in and promoting awareness of astronomy and providing an educational experience. The majority of participants in this study indicated educating audiences about specific content as one of their goals for

the planetarium (see Table 2). This included addressing alternative conceptions that are often held regarding common astronomical topics such as the phases of the moon and the cause of the seasons. Short interventions, such as experiences in the planetarium (Bishop, 1980; Plummer, 2009; Sarrazine, 2005) or museum visits (Falk & Storksdieck, 2005, 2009; see Rennie & McClafferty, 1996 for a review), have resulted in audience learning. The second most frequent response regarding goals of the planetarium was to engage audiences to increase their interest in astronomy or science. This included responses that indicated that a planetarium should inspire interest and create emotional reaction that make audience members want to come back. There is some indication that planetariums can increase interest in astronomical topics (Mallon & Bruce, 1982; Mergler, 1975) though at this time we lack a detailed understanding of what particular characteristics of the audience and the programming produce specific types of interest (see Falk & Storksdieck, 2005, for characteristics influencing learning). Other goals mentioned less frequently by participants included: provide an experience to audiences that reach specific educational goals, go beyond teaching facts and memorization, entertain, educate about scientific reasoning and skills, communicate information pertaining to observing the night sky and teach specific State or National science standards. It should be noted that the professionals' whose comments indicated entertainment as one of the goals of the planetarium still considered educational motives. These participants stated that entertainment is important to keep engagement so that the audience will be more motivated to learn and to keep their attention longer.

Table 2 – Goals for the Planetarium

General Goals	**n=28**	**Learning Goals for Children**	**n=30**
Education about content/Prior knowledge	20 (71%)	Interest/Engage	18 (60%)
Interest/Engage	19 (68%)	Education about content/Prior knowledge	17 (57%)
Provide an educational experience	8 (29%)	Teach State or National standards	13 (43%)
Not just facts	6 (21%)	Knowledge of the sky	7 (23%)
Entertainment	6 (21%)	Education about scientific reasoning	6 (20%)
Education about scientific reasoning	5 (18%)	Provide an educational experience	5 (17%)
Knowledge of the sky	4 (14%)	Not just facts	4 (13%)
Teach State or National standards	2 (7%)	Entertainment	0 (0%)

Note: Individual participants may have been coded in more than one possible goal.

When specifically asked about their goals for educating children (grades K – 4), participants mentioned engaging young audiences to increase their interest in astronomy or science as the most frequent response (Table 2). Educating audiences about specific content/addressing prior beliefs was still a frequently mentioned goal as well. There was a noticeable increased emphasis on teaching State or National standards when working with children. This can be interpreted as a response of the planetariums to meet the needs presented by formal education. Many children attend planetariums as part of a school field trip and therefore planetariums often assume the role of assisting formal educators in meeting specific State or National science standards. Interestingly, no participants in this study

mentioned entertainment as a key goal for programs that are designed to target children in the K-4 age range.

Opinions on Planetarium Program Design and the Views on Live Presentation

One of the goals of this study was to uncover planetarium professionals' views on show design for children, specifically grades K-4. Ninety-three percent (n=30) of the total interviewees who currently present in a planetarium indicated that they run programs for this age range in their domes. All participants were asked what they thought is important in the design of planetarium programs for children ages grade K – 4. The two most frequent responses were: presenting material at the appropriate level and including live interaction (Table 3). Other less frequently mentioned responses included: making programs that are visually appealing, being realistic, building on prior knowledge, good storytelling, being inspirational and including assessments.

Table 3 - Opinions on Planetarium Program Design for K-4

K-4 PT show design	**N=36**
Appropriate level	27 (75%)
Live interaction	24 (67%)
Visualization	8 (22%)
Realistic	7 (19%)
Prior knowledge	7 (19%)
Storytelling	4 (11%)
Inspirational	4 (11%)
Assessments	2 (6%)

Note: Individual participants may have been coded in more than one possible opinion.

Live Interaction

To better understand how live interaction is presently being used in the planetarium, participants were asked questions regarding live interaction.

Importance of Live Interaction: All participants were asked on a scale of 1 to 10 to rate the importance of live interaction in a planetarium program (with 10 being very important). The most frequent response was a "10" reported by 20 participants (while 3 others gave 11 or 12). Thirty-two (89%) participants rated the importance of live interaction with an 8 or higher. Two participants did not give a number although they both verbally supported live interaction in planetarium programs. All participants who indicated that they currently present in the planetarium stated that they give live programs at their facilities (n=30).

Defining Live Interaction: While these responses indicate live interaction's importance to planetarium operators, there are a broad range of strategies mentioned by professionals in how they *defined and described* using live interaction. The major codes uncovered in the interview data include: use of

questions, dialog, physical interaction (including kinesthetic activities and the use of props), and general engagement. Table 4 indicates the frequency of various definitions of live interaction.

Table 4 - Planetarium Professionals' Definitions of Live Interaction

Define Live Interaction	**N = 36**
Operator asking questions	26 (72%)
Kinesthetic activities	25 (69%)
Use of props	22 (61%)
General engagement	16 (44%)
Audience members asking questions	13 (36%)
Questions and answers during the program	11 (31%)
Dialog	10 (28%)
Giving instructions	3 (8%)
Use of clickers	3 (8%)
Questions after the program	1 (3%)

Note: Individual participants may have been coded in more than one possible definition.

Use of questions: We looked for evidence of both operators and audience members *asking questions* as part of our participants' definitions of live interaction. The initial codes developed included: evidence of operators using questions during the show, operators using questions after the show, and just a general use of operator questions. Despite predicting that question/answer after the program would be a commonly mentioned aspect of live interaction, only one professional mentioned this in their interview. Eleven professionals (31%) mentioned using questions during the show is part of live interaction. Twenty-six professionals (72%) included operators asking audience members questions as part of their definition of live interaction. Thirteen professionals (36%) also suggested that the audience asking questions is part of the definition of a live interaction.

Dialog: Ten professionals (28%) described *dialog* as an aspect of interaction in the planetarium. One professional included audience members talking to one another. The rest described general conversation, presenter talking to the audience, or active discussion. Three responses indicated the operator *giving instructions* as part of live interaction.

Physical interaction: The *use of props* was surprisingly popular with twenty-two participants (61%) including the use of a physical prop as part of their definition of live interactions. Thirteen (36%) of these people clearly indicated audience members use of props as part of live interaction, and all of these people spoke in ways that indicate they use these specifically in their practice. The remaining participants either use props as demonstrations or the use was unclear. Props included utilizing light ropes, light sabers, balls, models, and diffraction gratings among many others. Twenty-five participants (69%) indicated the use of *kinesthetic activities* in their definition of live interaction (examples require the audience to move but do not specifically require the use of a physical prop). The most common ways kinesthetic interaction was mentioned was in simulations and role playing, pointing and tracing,

and generic references to kinesthetic actions. Three participants mentioned *clickers*, and only one of these was referring to their own practice.

General engagement: We found a broad range of additional aspects of participants' definition of live interaction which did not otherwise fit the previous categories. These included: challenge them, engage through seeing audiences' blank look, scientific inquiry and exploration, communicate enthusiasm, relate to them/make it personal, direct eye contact, change presentation approach or level in response to differences in the audience, humor, and be animated.

Combining Live with Automated Programming

Knowing that live interaction is valued in the planetarium community, the question becomes, can fulldome (or automated) programs be utilized in combination with live components? In fact, combining live interaction with automated programming is not uncommon among planetarium professionals; but there is a great variety in the ways this is accomplished. Twenty-six (87%; n=30) reported that they have combined live interaction with automated programming and three (10%) reported that they have not (one unclear). Six participants were not asked because they were unemployed, an independent contractor, or a vendor.

How Live and Automated Are Combined: There are a variety of ways that the participants indicated how they have mixed live presentation with automated programming (Table 5). The most frequent responses were to include live presentation after an automated program, such as a star ID talk, and to include automated segments (e.g. video clips, musical segments, etc.) within a live program. Some of the other reported ways of mixing live presentation with automated programming included: an automated section at the end of a live presentation, pause automated programs or clips to add live segments in a presentation, a live presenter talking to an automated character, and talking over video clips. These all indicate the professional communities' willingness and desire to combine both live and automated formats to create meaningful presentations.

Table 5 – Methods of Combining Live with Automated Programming

Mixing Live Content	**n=28[a]**
Live segment following an automated program	14 (50%)
Automated segments embedded in a live program	14 (50%)
Live segments before automated segments	8 (29%)
Multiple stops and starts of automated program to add live segments	8 (29%)
Live segments embedded in automated program	4 (14%)

Note: Individual participants may have been coded in more than one possible method.

[a]One of these participants only gives live programs.

Opinions on a Modular Fulldome Program Design

Participants were asked about their opinions on a modular automated program design that would have built-in embedded live interaction components. Of those asked, 90% stated that they would run such a program. Some participants simply expressed interest or a positive reaction to the design others described a range of benefits of the proposed program design. The modular design would allow for more flexibility to adjust vocabulary, pace and content focus. The short modules would give audience members more control of their learning experience, allowing them the opportunity to ask questions within minutes of seeing the automated modules rather than after a 30-minute watch-and-wait period (typical of most programs) in which many audience members may forget their questions. Many described how this would especially help engage a young audience. The modular program would work better than a fully automated show because children have a short attention span and the program will switch modes throughout the show. Shorter instructional interventions would better address children's attention span limits (Ruff & Lawson, 1990). At least seven participants (19%) referred to the fact that they favor this because they have been doing something like this for years in-house or they cited a few key examples of program with similar features that have been run in the past (Big Bird, Planet Trek, Don't Duck Look Up!, and the Bishop Planetarium's Explorer Series). Other benefits mentioned by the participants included the ability to incorporate on-the-spot evaluation and that this kind of program will attract the right kind of planetarium operator.

Eighteen professionals (50%) described possible concerns about the modular fulldome program. Eight of these concerns were related to live presenters. Participants expressed apprehension that the operators might not be knowledgeable enough, comfortable with interaction, or able to manage the situation. A broad range of additional concerns were expressed, some of which seem to be based on misconceptions about the specific design we have in mind (use of materials, need for tables or desks). Some concerns were about the specific nature (in terms of content or context) of the show. Others were worried about making sure that all of the audience members had the chance to participate or alternatively, that management issues, making sure that audience doesn't get too "rambunctious."

Participants were asked to describe how a modular fulldome program might impact children learning from their experience in the planetarium (Table 6). Seventeen (57%) of the interviewees indicated that the modular design is more in-line with how people learn best. Another thirteen (43%) felt that the modular design would increase the audiences engagement throughout their experience. Many of these participants felt that audience members (especially children) are more likely to keep their focus when they know a live person will be engaging them throughout the program. Other responses on how the modular design might impact children learning included an increased amount of flexibility and a more audience-centered experience. The modular design would allow the planetarium presenters the opportunity to alter a program as a response to the particular audience's needs or abilities. Similarly, this design would give audience members more control of their learning experience by providing them with more opportunities to participate and ask questions.

Table 6 – Impact of Modular Design on Children Learning

Impact on Student Learning	n=30
Better fit with how people learn	17 (57%)
Increased engagement	13 (43%)
Increase flexibility	7 (23%)
Greater audience-centered experience	5 (17%)

Note: Individual participants may have been coded in more than one possible impact.

Conclusion

This study extends our understanding of planetarium professionals by describing their knowledge, beliefs, and interests towards the planetarium as an educational venue. This work builds on Croft's (2008) study of seven leaders in the planetarium field. He concluded that planetarium professionals are far more interested in educating their audiences than entertaining them. The present study confirms those results by sampling a larger and potentially more representative sample of professionals. We also found that subjects in both studies described the importance of conveying scientific ideas at an appropriate level. This was the most important consideration from our participants in program design for younger audiences. Similarly, our results support Crofts' finding that planetarium professionals believe that improving attitudes and interest in science is a goal of their work. Differences were also found. Croft found that planetarium professionals in his sample expressed a desire to pose questions about "the meaning and value of human existence" (p. 14), a sentiment not expressed by our sample. However these differences could be due to either the actual professionals that each study sampled or the nature of our interview questions.

We conclude that planetarium professionals almost universally believe in the importance of live interaction in their work, but that there are a variety of forms that this interaction takes. That many professionals use kinesthetic and haptic learning strategies as well as dialog in their programs is promising for the educational value of planetarium programming. And planetarium professionals' interest in combining the positive qualities of an automated planetarium program with live interaction opportunities suggests that the field will support non-traditional fulldome programming. Specifically, participants expressed positive interest in the modular show design which combines multiple opportunities for combining live interaction and fulldome automation. We conclude that the current fulldome passive programming is not necessarily the optimal experience that professionals in the field want to provide their audiences.

The results of this study have implications for the direction of the field. Planetarium professionals want educationally-oriented programs that offer the opportunity to interact with their audiences. Vendors (those that produce planetarium programming) may wish to consider these interests by designing programs that offer presenters the opportunity to be flexible in their use of the fulldome planetarium capabilities. The proposed format investigated here, a modular automated program design, was approved of by the study participants and thus offers a potential direction for planetarium producers to

consider. The large representation by educational venues (such as school-based planetariums) further suggests a need for flexible, participatory oriented, planetarium programs that are aimed at younger audiences. A second implication of this study is addressed to those interested in providing professional development opportunities for planetarium professionals. Given that planetarium professionals believe in both the importance of educating audiences on scientific content and interacting live with their audiences, successful professional development can begin by offering opportunities for professionals to add to their repertoire of live interaction strategies. Nearly all of the professionals who actively work in the planetarium work with elementary-aged audiences. This suggests that professional development opportunities designed to help professionals develop interactive strategies around standard elementary astronomy content would be well received.

A specific limitation of this study was that it scarcely (if at all) included the opinions of the decision makers that are responsible for actually producing commercial quality fulldome productions. Are there specific reasons why fulldome planetarium program producers are predominantly making passive programs rather than programs designed to facilitate active engagement? Are there multiple cohorts in the planetarium community that put different value to the types of experiences that audiences can have in a planetarium (educators vs. "movie-makers")? Future research exploring these questions will help the field move forward in increasing the educational value of the planetarium.

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Appendix A

Demographics

1. Did you listen to our presentation?
2. What is your current job? (If the answer is not clear, How does this relate to the planetarium field?)
3. How long have you been in the planetarium field?
4. What is you background in astronomy, science, or education?
5. Do you have any formal education training?
6. What kind of professional development have you participated in related to planetarium work or teaching?
7. Do you have full dome technology in your planetarium? [If interviewee does not work in a planetarium, Do you have any interaction with full dome technology?] Do you foresee having it in the near future?
8. Do you choose or are you part of a team that chooses which shows to purchase for your facility?
9. Do you run live shows?
10. Have you ever mixed live content with a pre-recorded show? Describe.
11. Do you run shows that cater to K-4 grades? If not, what other groups?
12. Does anyone else besides you run shows? What is the general training and background of the people who run your shows?

Opinion about general show characteristics

1. What are your goals for audiences in the planetarium? Or, what do you consider to be the central role of the planetarium?
2. What should K-4 grade students be learning from attending a planetarium program?
3. Do you have any goals for K-4 grade students in terms of their interests after attending a planetarium program?
4. What do you think is important in the design of a planetarium show for K-4 grade students? (Content? Execution? Length? Standards?)

5. On a scale of 1-10 with 10 being most important, how important is live interaction for educating K-4 students? (Make sure they explain.)
6. How do you define live interaction and what aspects are most important? (Give examples.)
7. Do you use question/answer during (not just after) a show?
8. Do you involve the students in ways beyond question and answer (such as using their bodies or through the use of props)?
9. What has influenced how you use live interaction in planetarium programs?
10. Where do you get new ideas for or learn new ways of interacting with audiences?

Opinion about modular fulldome

11. What do you think about a show design that is full-dome but modular with live sections interspersed with fulldome content?
    a. How might the impact on student learning be different than a completely-automated fulldome show for K-4 students?
12. Would you run a modular full dome show at your facility?
    a. Why/Why not?