

CHAPTER V

CONCLUSIONS, DISCUSSION, IMPLICATIONS FOR PRACTICE, AND RECOMMENDATIONS FOR FUTURE RESEARCH

In this chapter conclusions are drawn for each of the five domains covered in the survey, results are discussed, implications for practice are posed, and recommendations for future research in the field of planetarium education are presented.

Conclusions

The respondents provided an overview of what is going on in public-school-owned planetaria across the United States. Almost half of the directors added extra notes to the survey that provided a plethora of information regarding the daily operation of their facilities. It is clear that planetaria in public school systems across the United States are loosely coupled (Weick, 1976) to school systems and have only marginal similarities with regard to curriculum and daily use.

Planetaria in the United States are not in the educational mainstream as they were 20 years ago. Planetarium facilities located in public school systems today tend to be three decades old and not maintained well. Although new technology is being added to some public-school-owned planetaria in the form of video projectors, less than half of the facilities have any form of automation.

Although planetaria appear not to be in the educational mainstream as they were 20 years ago, their importance in today's educational system should not be understated. These educational facilities are still the most sophisticated audio-visual devices ever invented to assist teachers in the instruction of astronomy and related topics. These facilities are dynamic learning centers when properly staffed and maintained. It is possible that students benefit in ways not yet tested or clearly understood following instruction in a public-school-owned planetarium.

While the present focus in today's educational institutions may have shifted from planetarium facilities to other areas, the understanding of humankind's place in the universe remains one of the most important questions facing humankind today. Students of tomorrow will be working and living in space more frequently than ever before. Our basic understanding of the universe will be more important than ever before and this understanding must start early in the educational process of our students. School districts should consider the addition of a planetarium facility as a sound educational investment, and commit to supporting the facility in order to make it a valuable educational tool.

The Work of Directors

The job of planetarium director is a mixture of duties, tasks, and skills. The director's main duties are writing curriculum and scheduling student visits to the

planetarium. They see themselves as teachers and as the policy-makers for the planetarium. They are also the administrators of the facilities. They are usually assigned other duties than operating the planetarium; some spend as much as 80 percent of their time on duties outside the planetarium; thus, the planetarium is not their primary job.

Directors perform multiple tasks. More than half of all respondents reported performing at least seven of the 14 job tasks listed in the survey. In some cases directors indicated they performed all the maintenance and repair on the planetarium equipment, and it was their skill that kept the planetarium open and functional.

Teaching in a Planetarium

Directors reported teaching two or more classes per day in the planetarium and commented that the rest of their day was spent teaching in a traditional classroom. Some directors reported no regular classes taught in the planetarium and stated the planetarium is used only once a week or a few times per semester when astronomy or space science are being taught. In additional comments added by some directors, they reported the planetarium was only being used as a result of the personal interest of the director. In these cases the planetarium was being operated on donated time beyond school hours.

Curriculum in Planetaria

The planetarium experience is considered part of the science curriculum in almost two-thirds of the reported cases. Planetarium lessons are generally integrated into the science curriculum, and directors believe principals consider the planetarium a valuable educational tool. Teachers are involved in the development of planetarium curriculum in about half of the districts and a little less than half of the planetaria had lesson guides for K - 6. There were even fewer districts with guides at the secondary level. Thus, the curriculum seems to reside in a large number of districts in the hands of the planetarium director.

In about three-quarters of the reported cases directors have developed curricula designed to encourage student participation. This finding indicates that directors are moving their curricula in the direction of recent research findings that indicate that participatory planetarium programs are superior to traditional show-and-tell programs (Bishop, 1980; Fletcher, 1980; Mallon, 1980). However, directors added comments on their surveys indicating participatory programs were often difficult in the planetarium environment due to the darkened room.

State-Mandated Curriculum

Less than a third of the directors reported their lessons were based on state-mandated curriculum. Some directors commented that new curriculum guidelines were being developed using newly formulated state guidelines.

Grade Levels that Use the Planetarium

Generally speaking planetaria are used across all grade levels. With the exception of grade 7, the planetaria were used by grades K - 12 in over half of the school districts. Grade 7 had the lowest usage across all grade levels.

Usage across elementary and middle grade levels was as expected. There was an increase in usage up to grade 5 and a decrease in usage in grade 6. The greatest use in the elementary grades was as expected, with grades 3, 4, and 5 being the highest.

Number of Visits Per Year

The data on the number of times students visit the planetarium are in error due to a misunderstanding on the survey question. Respondents were asked how many times each grade level visited the planetarium during the school year. I wanted to know how many times a particular classroom of students would use the facility. Respondents reported a number of different answers. Some reported the number of times they presented programs for a particular grade level. The unusually

high number of 300 visits reported for some grade levels would be impossible during a 180 day academic year unless the students visited the planetarium more than once per day. This would be highly unlikely in most public-school-owned planetaria.

Curriculum Topics

The curriculum topics for the elementary grades were as expected. The topics “Solar System” and “Constellation Identification” dominated grades 3 and 4. Simple topics such as “Day and Night” were taught in the lower grade levels. More advanced topics such as “Stellar Evolution” and “The Universe” were reserved for the higher grade levels. As expected, the most widely used topics in the planetarium were the “Solar System” and “Constellation Identification.” Directors reported lessons are usually a mixture of some main topic along with stars and constellations.

Organizational Structure of Planetaria

Classification of Directors

The title “director” is used throughout the planetarium community as the title of anyone operating a planetarium. In most cases reported, the person operating the planetarium is classified by their school administration as a teacher.

Very few directors are classified as school administrators. Overall, directors are considered teachers assigned to the planetarium as part of their teaching duties.

Supervision of the Planetarium

Most directors report to either a principal or a science supervisor as their immediate supervisor. Few directors supervise other staff members and, as expected, they perform all of the work duties and tasks without assistance. Because of the loose coupling of the planetarium with the school district, many directors are the sole policy-makers for the planetarium.

The Planetarium Facility

The building of planetarium facilities parallels the development of the space program in the United States. With the launch of the first artificial satellite into space in 1957, planetarium facilities began to show up in American public schools and universities. Planetarium facility construction reached its highest level between the years 1966 and 1970. Since 1971 there has been a steady decline in the number of facilities built each year. The most dominant planetarium manufacturer is Spitz Inc. which installed most of the public-school-owned planetaria in the United States. Directors overwhelmingly recommended the planetarium not be designed for uses other than a planetarium.

Funding of Facilities

Funding planetaria construction in the early 1960s was a federal effort. The National Defense Education Act (NDEA) funded or match-funded many public-school-planetarium facilities. Today, the effort has shifted to the district level with some planetaria funded by grants or private money. District funding was the most reported method and is often incorporated into the construction lists of new facilities. Many directors reported they did not know the funding method used for their facility.

Location of Facilities

Planetarium facilities are located in school districts of all sizes. Even in districts with enrollments of less than 300 have planetaria. The largest districts often have several planetaria serving students. The largest district in the survey had an enrollment of over 1,000,000 students and was served by 15 planetarium facilities in its district.

Planetaria are located in a variety of places within a public school system. More than 70 percent are attached to a public school. A few are located adjacent to the school district's administration building. Most are located in middle or secondary schools.

Facility Size

Overall, directors recommended that the planetarium facility be moderate in size. Most directors recommended a dome of 30 feet in diameter and seating for 60 students. The directors recommended that exhibit and work areas be placed adjacent to the planetarium. Exhibit areas are not readily available in most planetaria. Exhibits are often placed in the entrance or lobby of the planetarium

Community Use of Facilities

Community use of public-school-owned planetaria was lower than expected. While a majority of planetaria offer lessons to groups not enrolled in the public school system, less than one-fourth of public-school-owned planetaria are used by community colleges or universities. The low usage by community colleges and universities may be due to the fact that 22 percent of them own planetaria (Petersen, 1998).

The number of public-school-owned planetaria offering public programs was also lower than expected. Slightly more than half offer public programs to their communities. The median number is one program per month and three programs per year. The directors believe this low usage may be due to the lack of support of the school administration for planetarium. Administrators appear to have marginalized (Batch, 1991) planetaria in their school systems. Another possible

reason is the fact most planetaria are open only during the academic school year, approximately 180 days.

Discussion

Return Rate

The return rate (62 %) of this survey was not as high as expected. This was possibly due to the data base used to secure the names, addresses, and locations of public-school-owned planetaria. Although the data base was a 1998 edition (Petersen, 1998), it possibly was only updated as new information was added each year. Old information was not deleted, and many planetarium facilities now closed still appear in the data.

The Marginality of Planetaria

Many public-school-owned planetaria are “marginal organizations” (Batch, 1991). They are not being supported well either academically or financially; thus, they are not being used to their fullest potential. This is confirmed by directors reporting they spend little time on duties involving the planetarium. They spend, on average, less than half a day each day on planetarium duties. In some cases the director is a school employee with sufficient interest in the planetarium to keep the planetarium open for the benefit of the students.

The Planetarium as an Instructional Tool

There has been some controversy on the effectiveness of the planetarium as a teaching tool. Past researchers have indicated the planetarium is a valuable resource in the teaching of space science and astronomy, but some of the literature also reveals researchers disagree as to whether a planetarium is necessary for teaching these concepts (Reed, 1970; Rosemergy, 1967; 1966; Sunal, 1976).

According to this study, most planetaria are not being used to the fullest potential. On the average, planetaria are being used to teach slightly more than two classes per day, and planetarium lessons are being taught to less than 82 students per day. Directors, in most cases, are not allowed to devote their full time to the planetarium.

While the number of classes being taught per day is slightly more than two, this may not be an accurate account for many public school planetaria. Planetaria that are being supported by their school districts tend to have more than two classes per day and greater daily usage than indicated by the data.

Researchers (Dobson, 1983; Hayward, 1976; Ridly, 1974) have indicated the importance of linking the planetarium experience with regular classroom instruction. For a planetarium to be effective, teachers must be involved in the development of the planetarium curriculum, and the planetarium curriculum must be integrated into

the science curriculum of the district. The curriculum must be linked to what is being taught in the classroom, and teachers must prepare their students for the planetarium experience. The planetarium should be used to support, not replace, classroom instruction. Planetarium lessons should not be show-and-tell lessons, and students should be encouraged to participate whenever possible.

Planetarium Curriculum

State-mandated curricula were in less than a third of the surveyed planetaria. A reason for this is possibly that state-mandated curricula do not include an abundance of astronomy or space science topics. Future research needs to be done to investigate state-mandated curricula with regard to space science and astronomy topics in the elementary and middle school levels.

Most planetaria seem to have aligned curriculum topics with student development levels. This corresponds to past research (Bishop, 1976) that indicates curricula needs to be aligned with the learning development of students.

Grade-Level Usage

Grade level usage was highest in the elementary school grades. There was a noticeable drop in grade 7. This drop may be because the curriculum for grade 7 does not have a space science or astronomy component. Based on my experience, most elementary and middle school students visit the planetarium one-to-five times

per year. Secondary grade levels visit the planetarium one or two times per year. Because a majority of planetaria are located in secondary schools, it is possible that some students visit the planetarium every day. This would be the case if an astronomy class was being taught in the planetarium. However, it would be misleading to suggest that most students at any one grade level visit the planetarium daily. The number of times students in a given district visit the planetarium more than likely depends on a number of factors such as the support for the planetarium, the size of the school district, the number of planetaria in the district, and the distance between the school and the planetarium facility.

Planetarium Facilities

Contrary to the information obtained from two planetarium manufacturers, the number of planetaria built per year over the last 10 years has not increased. In fact, there has been a decline. This decline in the number of facilities being built may be due to the overall decline in interest in America's space program. Another reason for the decline may be due to cost. The cost of most planetarium star-projectors has increased over 100 times that of 40 years ago.

Planetaria are often marketed by manufacturers as multi-purpose facilities. This idea of a multi-purpose facility appeals to school boards and administrators;

however, this researcher strongly agrees with those respondents who believe that a planetarium facility should only be used as a planetarium.

The large percentage of planetaria located in middle and secondary schools may be due to the inclusion of more advanced curriculum topics at these upper grade levels. Geographical location may be another reason. Middle and secondary schools are often more centrally located within school districts. There may also be a perception that these facilities are easier to fund when placed in a higher grade school. It is curious that the least number of planetaria are located in elementary schools which have the highest usage.

When directors were asked whether the planetarium should be a separate building they responded “no” at a ratio of almost 3:1. This was a surprise to this researcher because most directors operate their planetaria autonomously within their districts. Having the planetarium attached to a school building may have advantages not explored by this study.

The Director

The planetarium director’s skills are important in making the planetarium an effective educational tool (Fletcher, 1980). I strongly agree that the planetarium, which is a complex audio-visual device, requires a person with the necessary skills

to create planetarium lessons that are both educationally challenging and stimulating. Directors must be creative individuals with strong communication skills.

Directors are classified as teachers in most cases. Very few are considered administrators. Because most planetaria serve all the schools in a district, people get the impression that the job of planetarium director is an administrative position. This impression is reinforced because many school systems have administrative positions with the title “director,” planetarium directors schedule other schools in the district, and they have contact with principals and other school administrators on a daily basis. These administrative duties and relationships make the director appear to be a school administrator to others.

Implications for Practice

This study has implications for public school administrators across the nation considering the addition of a planetarium facility. In this day of high accountability for school boards, it is imperative decisions to build additional school facilities be based on careful evaluation and research. Planetarium facilities are costly, and their inclusion in the academic program must be based on sound logic and understanding of what may be expected from this type of expenditure. Planetaria are complex educational tools and will only be effective if installed correctly, staffed adequately, and supported by the administration.

A commitment by the school board to support the facility, both financially and academically, should be one of the first issues addressed. Often, planetarium facilities are built and then left to fend for themselves. The planetarium must be included in the academic process to be successful. The planetarium's curriculum must be part of the overall school curriculum, and teachers and school administrators must be involved in the development of that curriculum. It must be clear to all within the school system that the planetarium is part of the learning process and not just a "field trip."

Another factor important to the success of a public-school-owned planetarium is the person selected as the director. This individual must be creative, have a background in education, and possess a working knowledge of space science and astronomy. This individual should be a certified teacher with certification in a science-related field. The individual must be able to communicate effectively, have an interest in the sciences, and be enthusiastic about sharing that interest with others. The planetarium director should be assigned to the planetarium on a full-time basis. Other teaching duties should not be assigned. Overall, the success of the facility will depend on two things: the support of the school administration and the quality of the individual hired to be the planetarium director.

With regard to the physical planetarium facility, most directors indicated the planetarium facility should be located within a public school building. I recommend that the planetarium **not** be located in a school building. Because most planetaria operate autonomously within their districts, having the facility inside a school may create scheduling conflicts and student traffic-flow problems as students from other schools visit the planetarium. Having the facility inside a school may make community use difficult or impossible. If the facility is to be used by all the schools in the district and the community, it should be centrally located and, if possible, adjacent to a complex that is easily accessible to the community.

The planetarium facility should be a sound-proof structure. All heating and air conditioning equipment must be isolated from the facility. There should be adequate work space adjacent to the planetarium for the development, construction, and storage of equipment.

The planetarium star-projector and related equipment should be automated. This automation should be expandable to include the future addition of equipment. The automation system should be based on an industry standard such as the standard developed by the Society of Motion Picture and Television Engineers (SMPTE).

There should be an exhibit area adjacent to the facility if the planetarium is to be used by all schools in the district. The area should be large enough to accommodate 60 students and a variety of exhibits designed to enhance the learning experience.

Recommendations for Future Research

Recommendations for future studies on planetaria in education are as follows:

1. This study could be replicated using portable planetaria in public schools.

These smaller and less expensive planetaria are being used increasingly in public school districts across the nation. The curriculum and daily use of these portable planetaria might be compared to the curriculum and daily use of the larger, non-portable facilities. The study might include details on the training of personnel operating these portable planetaria.

2. A study of public-school-owned planetaria on a state-wide level investigating teacher perceptions of the effectiveness of the planetarium in instruction as compared to the traditional classroom could be conducted. A survey instrument could be developed allowing teachers to evaluate and compare classroom instruction to the planetarium experience in the areas of curriculum content, pertinence, understanding, motivation, and appropriateness for grade level.

3. A nationwide curriculum study of state-mandated curricula in space science and astronomy in the elementary, middle, or secondary grades could be conducted. The results of such a study would indicate the current need for advanced instructional aids such as planetaria and could affect future construction of public-school-owned planetaria.

4. A detailed study of the construction of a public-school-owned planetarium facility might be useful to those who are planning such a facility. The rationale to build the planetarium, a cost analysis for the facility, and the history of support or opposition for the facility could be included. The variables associated with the construction of the facility would be identified, and school districts considering the addition of a planetarium could use the results in their decision making.

5. Another possibility is a nationwide study of the development of visual literacy through programs in planetaria. The visual learning methods and materials used in planetarium instruction and their effectiveness would be compared to the visual learning methods used in the classroom. The relationship between visual learning and verbal learning would be included. Evaluation would be done using both teacher and student feedback and experimental techniques. Random selection and assignment of subjects would be possible in such an experiment.

6. A study of the needs and benefits of planetaria compared to traditional classroom instruction.