Spatial Evaluation of Elementary School Libraries: A Prototypical Assessment Instrument

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Abstract
Elementary school libraries are no longer spaces where books are stored and read. They are becoming or have become vibrant spaces hosting many activities fostering discovery, knowledge acquisition, expression and exchange. This paper aims at the development of an assessment methodology for such spaces from the perspective of all stakeholders including architects. The evaluation of their performance is essential to define their design criteria to improve their design and construction. The spatial data collected through the instrument is organized as 'Obtainable' and 'Observable'. Obtainable data are gathered from publicly available sources and by requesting the library personnel. Observable data is collected under the categories of '*Form and Environment'*, '*People*' and '*Activities*'. Such data are to be collected directly from the researcher by means of observation and to be recorded in a form. Under '*Form and Environment*', spatial data regarding the space is collected which is utilized to create organizational charts that would illustrate the spatial complexities of the facility. Under '*People*', data regarding the user characteristics such as occupancy pattern, items used here and activities taking place are collected. Under the third category of '*Activities*', each of the activity taking place shall form a sub heading from which it is deciphered how the space is utilized. The objective of this assessment instrument is the collection of spatial and related data that would eventually allow an evaluation. Early indications from testing the efficacy of the assessment instrument show that libraries are lively social spaces. The outcomes are indicative of the direction regarding the design of such spaces in these times.

Keywords: Spatial assessment, post occupancy evaluation, elementary school library, library design, learning commons.

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Introduction

The learning environment is one of the external factors of learning (Sanoff, Pasalar and Hashas, 2001, p.7) and in this case the learning environment is elementary school libraries. The design of the environment therefore has a significant effect on the learning experience learning (Sanoff et al., 2001, p.7). Advancement of technology over the past few decades have influenced the design of these libraries leading to their transformation (Reiser, 2001). The 'Learning Commons' which have replaced the 'library' are an indication of such transformation (Maxwell and French, 2016).

The topic concerns elementary school libraries from the point of view of architects and other spatial designers. Elementary school in Texas (from grade I to grade IV) have their own unique objectives in comparison to higher grade levels (Brookover, Schweitzer, Schneider, Beady, Flood, and Wisenbaker, 1978). School library as defined by the American Association of School Librarians (2018) is a library within a school where students and teachers among others have access to sources of information along with other resources. This study aims at the development of a methodology framework to collect spatial data of elementary school libraries. The research question to be eventually answered using the instrument is 'How have the purpose of elementary school libraries changed over the past three decades?'. The timeframe of three decades was chosen because that was when computers and internet facilities began to appear in school libraries (Gray, Thomas and Lewis, 2010**;** Cullom, 2013; Loertscher, 2018; Reiser, 2001). The context in this case is the planning and designing of such spaces in Texas. The purpose of this research is to assist architects and designers in developing the design criteria of such spaces.

Literature Study

Advancement in information and communication technologies has made knowledge available everywhere and accessible through a pocket device (Gensler 2015 and Loertscher, 2018). Though this might raise the question regarding the need for library space today, expert consensus concurs that libraries would continue to exist although their priorities shall evolve (Gensler, 2014, 2015).

Although school libraries in the United States have existed since the 19th century, it is only during the next century that they gained relevance as a place not only for books but also for other media as well (Siegler, 2005). Although it is widely accepted that libraries are much more than repositories for books, this knowledge is implicit in nature (Maxwell and French, 2016; Head, 2016). The information to design such spaces are not commonly available to architects and designers. As per a study on academic libraries, less than a third of the sample admitted having used formal methods to gather systematic user data from students or faculty as part of the planning process (Head, 2016). The implication is that most architects do not work in conjunction with the facility users who are the major stakeholders in schools (Head, 2016).

As of 2014, the median cost of construction of an elementary school in the United States is about $16 million in which the per capita cost of construction is $211 per student (School Planning and Management, 2015). The library is a distinct space in a school and requires significant investment to build (Gensler, 2015). The escalating

cost of construction necessitates the need to justify spaces such as libraries in a school (Gensler, 2015).

Gensler (2014), one of the largest architectural firms in the world, conducted studies on academic libraries to understand the activities happening there today and the future of such spaces. Such research is essential to gain a competitive advantage against entrenched competition who have been designing learning spaces for decades (Gensler, 2015). This requires financial capital obtained from client fees and so the value of the research must match the value of the resources expended (Gensler, 2015). Such work is a trade secret for these firms and is only made public at their discretion. This edges out smaller firms who lack the resources to conduct such research.

This research is on elementary school libraries as against academic libraries, so it is a different context where the learning objectives are different, the students are of a different age group and the activities are structured and supervised (Brookover et al., 1978). Elementary schools have different learning objectives in contrast to middle schools and high schools (Brookover et al., 1978). This research would help architecture firms (small and medium size) in developing design criteria of such spaces. This would create spaces that would enhance the learning experience of its users (Sanoff et al. 2001). This in turn would help school administrators to get the best return on their investment as the instrument would decipher the needs and requirement of today from such spaces (Gensler, 2015).

Post Occupancy Evaluation

Post-occupancy evaluation is defined as the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time (Preiser, White, and Rabinowitz, 2015). The objective of evaluation is to see if the project is meeting the original intentions and to judge its quality (Preiser et al., 2015). Assessment, on the other hand, is to compare a building's performance against a benchmark (Preiser et al., 2015). In this study, three building assessment frameworks were examined namely Evaluating Facilities: A Practical Approach to Post Occupancy Evaluation (1983), School Building Assessment Methods (2001) and Learning Space Rating System (2016).

Evaluating Facilities

Parshall and Peña (1983) formulated Evaluating Facilities: A Practical Approach to Post Occupancy Evaluation as a manual to assess building facilities by identifying how well it meets the original intentions. This manual was formulated by them during their stint at the Caudill, Rowlett and Scott architecture firm to aid building owners to measure the value of their facilities. The tool is meant for real estate executives and facility managers and is suitable to assess facilities ranging from multiple buildings in a complex to any clean room in a laboratory (Parshall and Peña, 1983). It does not specify any particular building typology to which it is most applicable. However, the framework needed in this study is meant for school stakeholders such as teachers, librarians, administrators and architects. So, the target group of 'Evaluating Facilities' differs from that of this study.

This tool is to be used within six months to two years of the occupation of the building whereas the libraries in this study could be decades old (Parshall and Peña, 1983).Although both qualitative and quantitative data is collected, the assessment is carried out by assigning scores to various parameters at the discretion of the user. The outcome is a 'Quality quotient score' (Parshall and Peña, 1983) but there is no benchmark against which the final score is to be compared. Ambiguity is observed in terms of factors such as 'creativity and excellence in design' and 'appropriate symbolism. Regardless of its drawbacks, for this study a tool is needed to collect specific spatial data on elementary school libraries to understand their purpose and to observe the manner such spaces are utilized today. For these reasons, this manual is unsuitable for the study at hand although it was useful reference to approach the subject of building assessment.

School Building Assessment Methods

The School Building Assessment Methods by Henry Sanoff (2001) provides a framework to assess K-12 schools. The tool is meant for stakeholders in schools such as teachers, students, parents, architects and administrators who are anticipating the expansion and construction of such buildings (Sanoff, 2001). The biggest strength of this tool is that it focuses on K-12 school facilities which are similar to this study and thus concerns itself with specific data relating to schools. The scale to which it is applicable ranges from an entire school complexes to a classroom (Sanoff, 2001). The tool primarily collects qualitative data and multiple techniques are employed. Some of the techniques are seven-point Likert scale, yes or no questionnaire, photo questionnaire, wish poems, group interactions and rating of layouts (Sanoff, 2001). The answers are primarily perceptual in nature which makes it limited for this study.

The goal of this method is to identify the stakeholder preference to arrive at the best facility design (Sanoff, 2001). However, in this study, the goal is to collect data from elementary school libraries to understand its evolution. This requires factual data as well as perceptual data. Keeping aside the difference in purpose and its limitations, this is a significant resource which aided the development of the assessment instrument.

Learning Space Rating System

Phil Long's (2016) Learning Space Assessment Method, published by Educause, aims to assess the design of classroom spaces in supporting active learning by defining a set of measurable parameters. Like the framework above, it is meant for school stakeholders such as learners and instructors to assess the performance of their facilities (Long, 2016). The scale of facility to which this tool is applicable is limited to a classroom making it more specialized in approach than the above framework (assessing a school complex versus a classroom).

There are two parts to this framework in which the first part is about context, planning and support. The second part is about environment, furnishings, layout and technology (Long, 2016). Overall, this framework has a rigid structure with a fixed set of questions. There are no open-ended questions in this method where subjective accounts could be documented. Valuable data in terms of preferences, opinion and experiences are missed out. Many of these headings and their parameters are

irrelevant for this study (such as maintenance of the facility, mechanical and electrical systems, etc.). Under these headings, there is a set of parameters which are to be assigned a score (Long, 2016). The outcome of this is a score to measure the classroom performance (Long, 2016). Ambiguity was observed in this tool regarding no clear definition of student performance. It is not explained the reasons behind the weightage of the parameters which are to be scored at the discretion of the researcher. There is a sub-section entitled 'Post-Occupancy Evaluation' which adds to the lack of clarity. However, this is a contemporary framework to assess such spaces and is a useful reference in this study

Data Collection Instrument

Elementary schools have their unique learning objectives in contrast to high schools and universities (Brookover et al., 1978). Although two of the methods discussed can assess school spaces, a framework is needed which is custom made for elementary schools only. Due to the deficiencies of the existing methods, a new data collection instrument was devised. The instrument's purpose is to collect spatial data on elementary school libraries only which shall then be assessed through comparison. This is to be achieved by applying the tool across schools of comparable sizes built in different points in time over the past three decades. The objective is to identify the changes happening in such spaces and identify the existing trends which would provide valuable design information to architects.

Through the instrument, both factual as well as perceptual data would be collected, and the data would be categorized under 'obtainable' and 'observable' data. Observable data are the kind which is to be obtained through an observation study by the researcher. The data is further categorized under *'Form and Environment', 'People' and 'Activity*' which are explained in the following paragraphs.

The techniques used to collect data involve qualitative research techniques (Hesse-Biber, 2017) such as semi-structured interviews and surveys of librarians. Quantitative data (Creswell and Guetterman, 2019) is obtained through observations and through existing records such as building drawings. Overall it is a qualitative research design in which quantitative data is used to support qualitative techniques (Hesse-Biber, 2017).

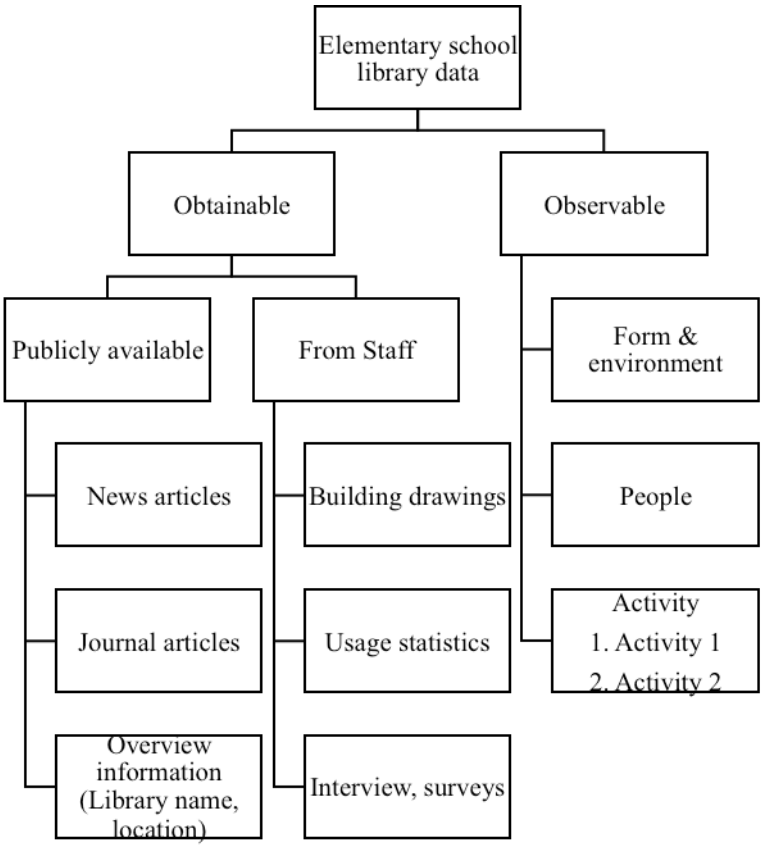

Table 1: Types of data in this study.

Obtainable Data

Obtainable data is collected primarily from the school librarian and other personnel. These include interviews and surveys of librarian and other school personnel. Library usage statistics, building drawings and library resource data also fall under this category. They also include existing journal and newspaper articles on the facility which would provide the relevant data.

Library overview data

The overview provides an outline of the facility within the school. Under the heading data such as school name, location, its year of construction and the total enrolment is recorded. The year of construction indicates if the facility was designed to accommodate equipment such as computers and internet which would be further reflected in its design. The year of construction of such libraries over the past three decades is to be compared against their area to see if the area of the facility has changed over time. The proportion of the library area against the school area is to be determined to observe the change. This would provide a starting point to examine how and why the transformation has taken place. It can be further compared against the total enrolment to see if the per capita area is witnessing a variation.

Semi structured interview

An in-depth account (Hesse-Biber, 2017) of the librarian is necessary to directly obtain facts and to understand the perceptions regarding the space. The interview

requires a structure because the objective is to obtain spatial data but there would information about the space which the researcher as an outsider may not be aware of (Hesse-Biber, 2017). To do so, a semi-open interview structure is adopted to capture the relevant data from the librarian (Hesse-Biber, 2017). An important question to consider if the volume of physical media such as books have changed over the years. From the pilot study, a trend of decreasing volume of books over the years has been observed as online resources such as eBooks are more accessible. Under such a circumstance, the librarian would be able to shed light on how the released space is utilized. In today's context, a librarian may no longer only be a bookkeeper but is viewed as a facilitator of education. This includes the work of a technology assistant where he/she is required to assist the teacher in setting up equipment, instruct students in using equipment among others. The librarian is to be asked regarding their views on their role in the school and the manner it has evolved over the years.

Building drawings

As part of data collection, building drawings such as plans are necessary to understand the space. However, such drawings are not easily available, but egress plans are publicly available. From the pilot study, the egress plan is used to construct the plan of the facility. The plan is to depict the shape of the facility with the layout of its furniture and equipment.

Adjacency diagram (White, 1986) are used to visualize the relationships between the functional areas in a building. Here, it is to observe if the spaces within the library complement or clash with each other. The spaces of the facility are represented in terms of bubbles of varying color to indicate different spaces. The size of the bubble is proportionate to the relative size of the space. In the pilot study, it was observed that the projector screen hung above the desktops. So, the desktops could not be used by a group if another group is using the projector. The spaces in this context were rigidly defined, such as the placement of the book stacks, the librarian check-out counter and the reading area furniture. There was no scope to rearrange the furniture in this case.

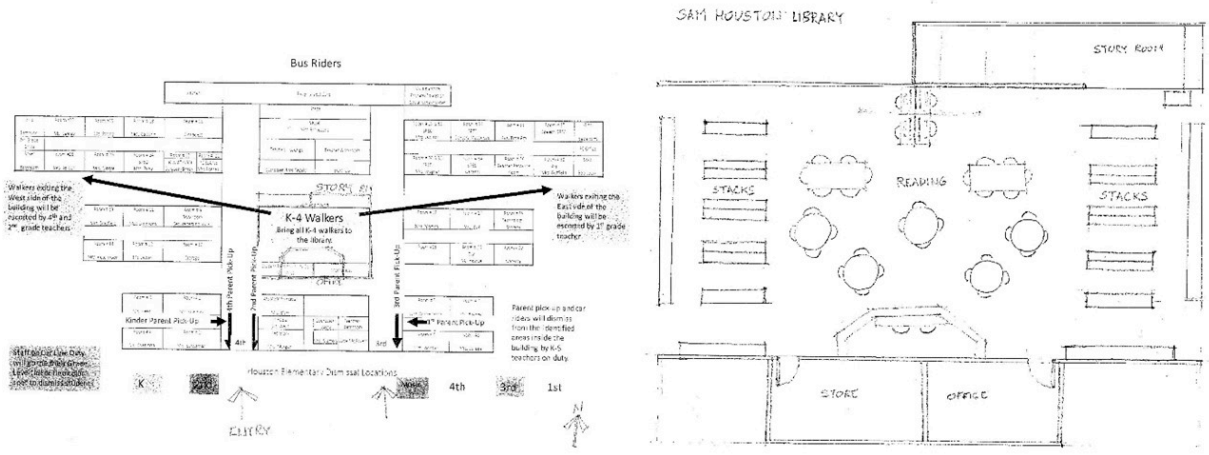

Figure 1 The plan of the library(right) constructed from the egress plan(left).

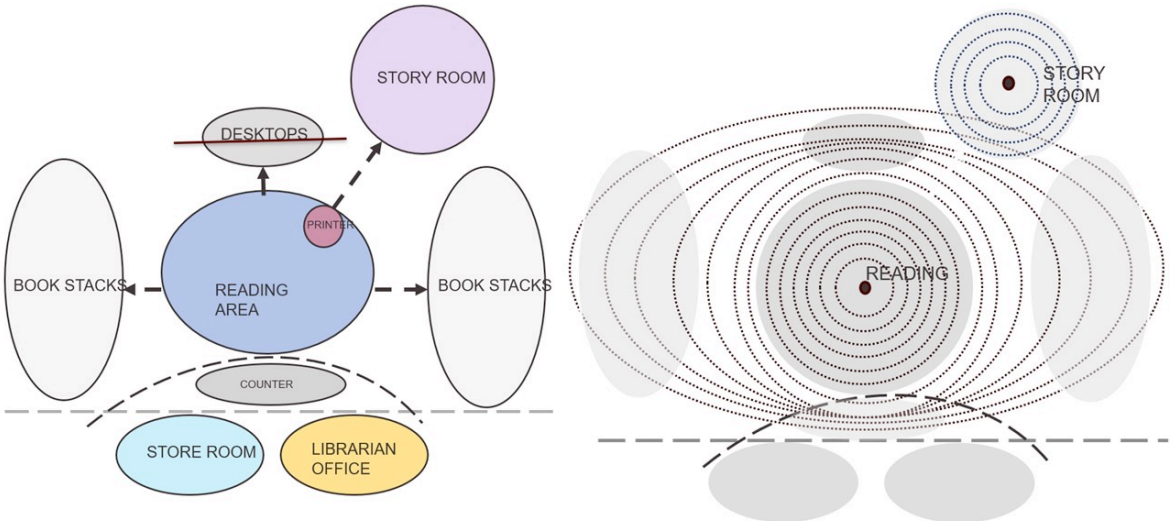

Figure 2 Adjacency diagram(left) and noise diagram(right) created from observations and building drawings.

Libraries today facilitate various activities which produce noise such as collaborative and presentation work (Maxwell and French, 2016). A diagram is therefore necessary to indicate the spaces which produce noise and if the noise spills out to other spaces. A noise level meter is used to measure the noise produced at different points in the library space. In the pilot study, it was observed that the noise produced from the reading area due to a presentation activity, was spilling out to the story-time room where silence is desirable. Such data would be instrumental in making design decisions regarding sound insulation.

People

The elementary school library is used by a range of users at different times of the day and is not limited to students (Gensler, 2016). From the pilot study, it was found out that the space is used by the faculty and the staff after school hours for meetings. The space is also used for Parent-Teacher Organization meetings. Many informal activities such as celebrations take place here. So, it is important that such data is captured by the instrument so that the design would be space keeping such users in mind. For this extent, the users of the space and their purpose are to be listed out, the total staff managing the space and the occupancy at the given hour. The occupancy would indicate how many users are in the space at the given hour and if multiple groups are using it.

Activity

This is the final section of the instrument where the objective is to observe the activities taking place. During the pilot study, it was realized that the researcher should spend one school day at the facility noting down all the activities taking place at different periods. This was to capture the spectrum of activities happening and to understand the dynamics of the space. From the observation and from literature, it was realized the activities taking place can be categorized into three classes, namely individual, collaborative and presentation (Fisher, 2007).

Here, individual activity is the type where a person is working on his own (Fisher, 2007). Here the activities could be reading, coloring, puzzle-solving, working on a desktop or even borrowing an item from the library. Items borrowed could either be taken home (such as a book) or is meant to be used only at the space itself (such as a laptop, tablet or a makerspace kit). For this end, a distinction must be made as this would determine the space needed for the usage of such equipment. During the pilot study, it was seen that the librarian did not spend any time within the check-out counter. If any student needed to borrow a book, the librarian would use the hand-held bar-code scanner standing outside the counter using only the table top. In this case the librarian had her own office, but she also had to perform duties other than being a keeper of books. This included being a technology assistant where she sets up equipment (such as laptops, desktops and projectors) and assist the teachers and students with such devices in the library as well as the class room. This required going around the facility and the school campus as well. This could be one possible explanation for the lack of usage of the check-out counter. Group activities (listed as collaboration activity) were also observed in the pilot study (Fisher, 2007). These included sharing of items such as colors and laptops, building, crafting, assembling and constructing. The space hosts extra-curricular activities of the school such as preparation for a celebration in which the students work in group. Other group activities are staff meetings and parent-teacher organization meetings which also take place here. All these data are to be collected from the librarian and observed if possible. The last type of activity is the presentation activity (Fisher, 2007). This is an instructional activity where the teacher or a student presents to a class using the projector in the library which may not be available in the classroom (Fisher, 2007).

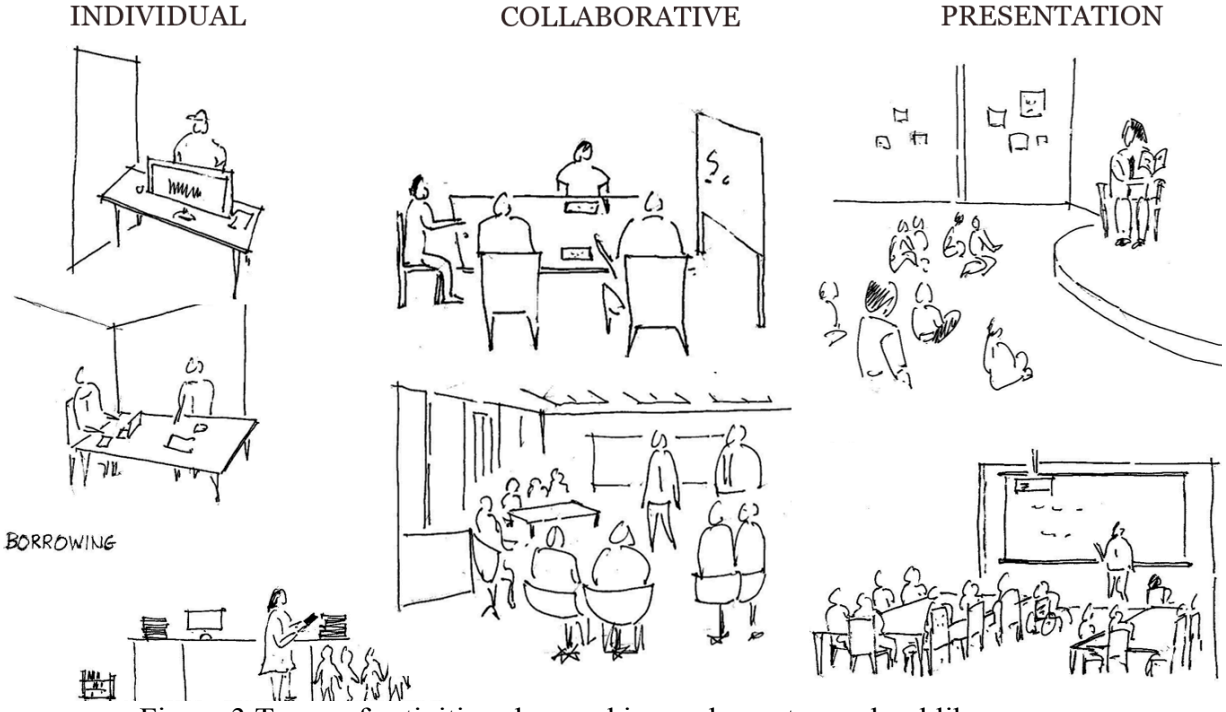

Figure 3 Types of activities observed in an elementary school library

The type of work observed can be classified as individual, group of two and group of three or more. At the same time, the items used by the students are to be recorded. This would indicate the way the facility is utilized. In the pilot study, it was observed that 75% of the users were using laptops at one time indicating the role of technology in such an environment.

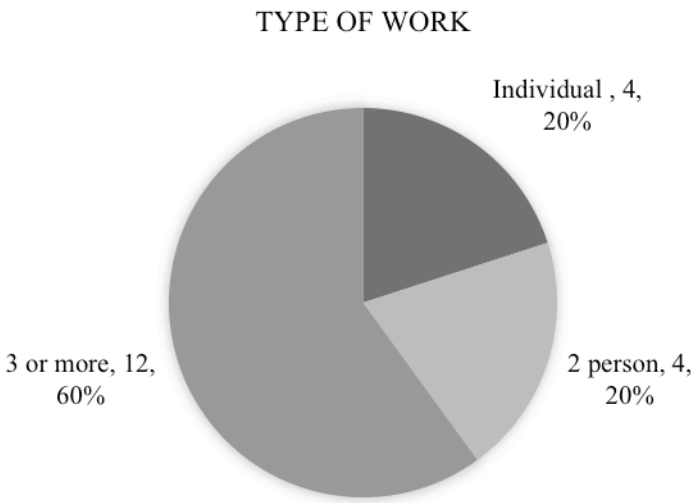

Figure 4 Type of work observed in a class period in the pilot study.

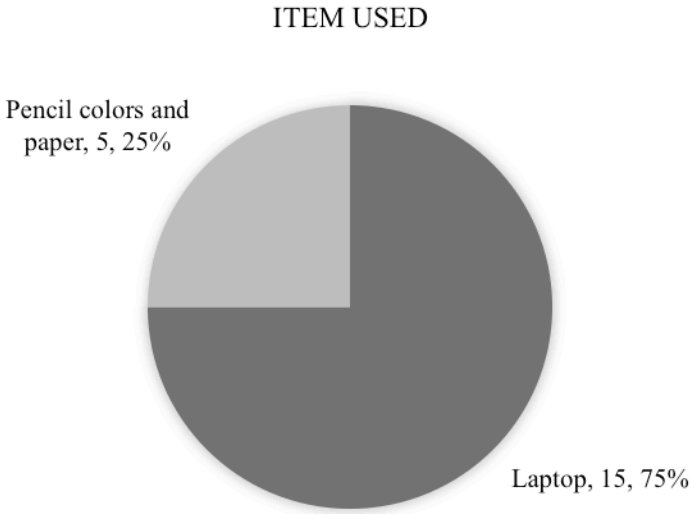

Figure 5 Items used by the students in the library in a typical class period.

The last part of the activity observation is to identify al the activities taking place and study the spatial characteristics of each activity. This begins with determining the approximate area required for the activity, followed by the geometry of the space. The data is to be indicated on the building drawings.

The next step is to collect the lighting data both in terms of quality and quantity (Boubekri, 2008). In this regard, both natural as well as artificial lighting is to be considered (Boubekri, 2008). It is to be seen if natural light through windows, clerestory light, skylights, glass walls or any other form of fenestration in used in the activity. Furthermore, glare from sunlight is to be accounted for. The fenestration details are to be recorded as in the number of openings, their sizes and location. For artificial lighting, the type of lighting fixture (troffer, strip light, track light, cove light, etc.) and the type of lamp (Light Emitting Diode, fluorescent, compact fluorescent, incandescent, etc.) are to be identified. The quantity, location, lamp

power and illuminance are to be noted. To record the illuminance, a photometer is to be used.

Apart from lighting, the noise is another important consideration in the activity. As libraries are no longer the quiet reading areas but are activity hubs (Maxwell and French, 2016), noise is inevitable. So, in this regard, the noise produced in an activity, such as a group work activity like presentation is to be recorded using a noise recorder. From this, it is to be seen if the noise produced by the activity is affecting any other activity in the proximity. For instance, it was seen in the pilot study that the noise produced during a faculty instruction spilled over to the story reading room where silence was desirable. However, in this particular case, only one classroom used the library at a time, so the noise produced was not disruptive.

Other spatial characteristics such as the enclosure characteristics are to be documented. The flooring pattern is to be indicated through floor plans if any space within the facility has such a distinct pattern to demarcate the space. The flooring materials such as carpet tiles, vinyl composition tiles, resilient rubber tiles, hardwood flooring or any other material is to be identified to see if any material is used for acoustic reasons. If the ceiling pattern is non-uniform, then it is to be depicted in a reflected ceiling plan. As for walls, it is to be identified if they serve any purpose in the form of a usable vertical surface such as displaying an item. The door material is to be identified (glass, steel, aluminum, etc.) and indicated if it is transparent to allow visibility. Furniture used in the activity is to be listed and described. The equipment used in the activity (such as projectors, laptops, tablets, etc.) are to be mentioned. These data relating to the activities taking place are therefore important.

Conclusion

Although other spatial data collection tools exist, they are generic in nature applicable to a variety of learning spaces. However, this instrument is devised to collect spatial data in the context of elementary school libraries in the United States. Specific qualitative as well as quantitative data is collected to gain a comprehensive understanding of the evolving purpose of such spaces. A pilot study was undertaken at a local elementary school to validate the instrument and the findings were incorporated in it. For instance, it was observed that although the school was the at center (literal and figurative) of curricular and extra-curricular activities. Although the facility was designed at a time when desktop computers were unavailable, today the school has bypassed the need for them due to laptops being cheaper and more convenient to use. Although the volume of books is decreasing over the years, the need for space in the library has not reduced as the library hosts multiple activities related to learning. The librarian checkout counter is a redundant space in the pilot study case due to the librarian's expanding role. However, this data cannot be generalized to all such libraries. For this end, this instrument is to be applied to multiple elementary school libraries built over the past three decades and the data is to be compared to understand the evolution of such spaces.

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