**Introduction**

The ways in which young children learn are understood in multiple different ways. The same processes are often explained and rationalized by many theories of learning processes and knowledge acquisition. Through our research of preschool learning spaces, we have found that most sites acknowledge only one or two learning theories on which they premise their special layout. Our design recognizes that there is no one “right” definition of how learning occurs and that at any time within a classroom there may be several types of learning occurring simultaneously. In addition, through the design of our space we wish to acknowledge that the ways in which children learn may evolve over time as their abilities to interact with peers, adults, and their environment become more sophisticated. Finally, the space that we have created is special, in our minds, because it encourages not only the children in the space to learn, but the adults as well. By encouraging teachers to take a critical look at the needs of their students and then creatively find ways to meet these needs by reorganizing the space, we feel that they will become more attuned to the processes that are occurring within their own classrooms and generate methods by which their students will become more independent, creative thinkers themselves.

**Users**

We have designed this space specifically for the future site of T’enna Preschool, to be located at the Jewish Community Center in Palo Alto, CA. The school is a private, not-for-profit early-childhood learning center that serves children ages 2-5. Each of the classrooms holds, at maximum, 20 children and, at minimum, 2 staff members, though the average ratio is 16 to 3 children to staff members. The primary goal of T’enna Preschool is to “develop each child’s self-esteem, promote positive feelings towards learning and to encourage social interactions within a Jewish preschool setting.” Currently they seek to accomplish this by utilizing child-centered and process-oriented curriculums. To date these curriculum exist without consideration of the ways in which space can benefit the learning outcomes of children.

Though we have designed this space with a specific site in mind, for us, one of the most attractive features of the space is the ease and affordability with which it could be replicated at other sites. In creating a space in which this replicability is possible, we have had to determine a set of learning goals that match with those set forth by the T’enna Preschool but that are also broad enough for recognition as valuable learning goals for other preschools and child development centers. These learning goals are derived from four major theories of learning and intelligence that we believe represent the breadth of experiences that cause learning to occur for young children.

- **Constructivist Theory of Learning:** Much of the development of this theory in the area of early childhood was done by Jerome Bruner\(^1\). This theory of learning states that the learner should be encouraged to make meaning of situations on their own, but that the teacher has the responsibility to structure the knowledge base so that it is accessible to the learner. Further, the curriculum should exist in a “spiral”, building on the previous experiences of the learner. In Toward a Theory of Instruction (1966), Bruner tells that knowledge should be structured to encourage “simplifying, generating new propositions, and increasing the manipulation of information.”

- **Multiple Intelligences:** Developed by Howard Gardner\(^2\), the theory of multiple intelligences states that there are varied types of intelligences that each person can access to different degrees. The implication of this theory is that learners should be able to utilize their stronger intelligences to engage with their environment and that,

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when possible, both instruction and assessment should appeal to the multiple intelligences\(^3\).

- **Situated Learning**: Based primarily on the work of Lave, later with Wegner, situated learning theory implies that learning is a function of the constructed environment in which it occurs and the social and cultural constructs that exist within this environment. As one becomes more attuned to the cultural and social interactions within a group, they become a "legitimate peripheral participant". Inherent in this is the need for learning to occur in authentic environments\(^4\). In preschool classrooms, this may take time, but once children feel as though they are prepared to interact, the amount of learning that can occur is great.

- **Social Development Theory of Learning**: Based in the research of Vgotsky\(^5\), this theory of learning relates experience to social interactions. Without the interaction with others, the learning does not occur because it is not given the meaning necessary for internalization. "Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological). This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All the higher functions originate as actual relationships between individuals." (Vygotsky, 1978).

By understanding our beliefs about learning as they relate to this context, we were able to generate learning goals that we wished to incorporate as we redesigned this space.

- **Learning Goal 1**: Children should be able to access the intended learning at an appropriate pace, determined primarily by the child.
  **Implications for learning space**: Space must be flexible to allow for children to be working on different learning activities at the same time.

- **Learning Goal 2**: Children should have ample opportunities to explore new phenomena and objects as individuals and as groups and should then be given time to process their new understandings with peers or teachers.
  **Implications for learning space**: Space must allow for easy mobility on the part of the teacher so that he or she can move within groups of children for reflection and discussion. Open areas for exploration are necessary. Space that allows for interchanging of new and interesting objects for display is necessary.

- **Learning Goal 3**: Each child should have the opportunity to access an understanding of the classroom environment in terms of cultural and social norms through their primary intelligences.
  **Implications for learning space**: Opportunities for each of the intelligences to flourish must exist. Because it is difficult to envision a preschool classroom that can offer distinct opportunities for learning opportunities at all times, this need can be met by offering a flexible space in which the intelligences that are reached shift as the space does.

Once we grounded ourselves in these learning goals, we began to imagine how these could be accomplished in the classroom that we were redesigning. The design principle that we continually came back to was that of “flexibility”. By creating a space that was flexible in layout and function, we see teachers who would have the freedom to imagine their classroom in terms of the needs of the children, rather than the constraints of the space. We recognize that this presents unique challenges on the part of the user, in our case, the teacher. Thus this

\(^3\) Gardner specifies seven intelligences: linguistic, musical, logical-mathematical, spatial, body-kinesthetic, intrapersonal and interpersonal, though in recent years, an eighth has been suggested: naturalist.


classroom is not for everyone. However, this classroom does have a life beyond the theories of learning and development that are in existence today. We cannot begin to imagine how our understanding of the brain will change over the next decades, but we can imagine how the space that we are proposing will be able to accommodate these new understandings while remaining grounded in research-based theories of learning that exist today.

**Description of Space**
Currently, the space is in development, though the layout is fixed by the following plans:

For our redesign of this space, we envision a classroom that is very flexible so that teachers can easily change the room to cater to what the children are interested in learning. Our classroom will consist of shelving that is 17x17 inches. These shelves will be study and “teacher movable,” meaning that teachers will have the ability to move the shelving easily, but children will not be able to move it. Another large highlight of the room will be the large projector that will be able to move linearly across the room to accommodate different furniture layouts, different activities, and separation of the space.

The third unique portion of the room consists of the cushions that are spread throughout the room. These cushions provide a soft space for the children while not covering the natural wood (bamboo in our prototype) floors. The natural elements in the room will create a mellow atmosphere for children to learn and play. These cushions can be used if a child needs rest, for games, or if the teacher finds it necessary to use them during circle time if children are having a hard time sitting still!

In our ideal classroom, the doors on the children’s personal cubbies will have different textures that they can explore. This matches the philosophies of Reggio Emilia which informs classroom design to include simple, natural materials for exploration. These cubby doors can be used for a variety of other purposes as well, such as showcasing children's artwork or putting pictures of their families to personalize the cubbies. In this way the space will feel more like an extension of the home.

Though not an element of the space that we designed, we would encourage users of this space to consider the outside as a natural extension of the classroom and as a resource for determining children's interests. In centers such as the Bing Nursery School at Stanford University, each classroom has a designated outside space that can be accessed by the children as they please. Though we see the value in allowing this free transition between the indoor and outdoor spaces, we have made a conscious decision not to recommend this type of space for T’enna. First and foremost, we are unable to recommend this because of the limited space available for the preschool as it is already in the first phases of construction. Secondly, while this type of classroom arrangement permits children to enter and exit the space at will,

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6 Courtesy of Zvi Weiss, Director, T’enna Preschool. Not to be reprinted without permission.
it extends the size of the classroom by 500%, thus reducing the interactions between children and between children and staff. We would recommend that T’enna continue to utilize their outdoor space as an environment for learning, but we have not included it as an aspect in our redesign.

**More about shelving**

The shelving is unique since it has the ability to be stacked and more easily moved than other shelving that is available. Additionally, the shelving will come in several different colors and types. The different types will include shelving that is placed on both sides of the furniture and the usual type of shelving that we see where the shelving is on one side of the furniture. The two-sided shelving can be used to rotate materials throughout the school year and can be used as a short term storage area. Storage area for teachers in our prototype room also consists of the same type of shelving, but stacked. The ability to stack the shelving easily can come in handy when a particular layout needs more shelving or less shelving in the learning area of the classroom.

**More about the colors**

In our prototype, the shelving is separated into four different colors in the classroom (and more colors in the teacher storage area). These colors can be helpful when directing the children to separate into learning groups. Additionally, the colors of the shelving will also help children remember where certain toys belong when the shelving is being moved on a regular basis. The colors do not have to be primary colors, but can be softer or more natural colors that might be more appropriate for younger children as it accommodates their ability to get easily excited. Much of the research from WestEd has shown that these natural, muted colors provide for a better learning space for younger preschoolers.

**More about the projector**

The projector will hang from the ceiling of the classroom, as will a large projector screen. Both the projector and screen will be able to move on a two dimensional plane across the room. The projector screen will extend low enough to the ground to accommodate shadow games for the children. Additionally, the screen will be made of a dense cloth that images can be projected onto, but shadows can be seen through them as well. The projector will add a dimension of flexibility to the room since any types of images can be projected onto the screen so that what children are learning about will appear to come to life. This set-up will also allow the children’s images to be projected, which will foster development of their fine and gross motor skills as they move in ways that will change the image that they are projecting. In addition, the act of feeling oneself move and then seeing the immediate effect that it has on the image projected will function to develop the placement of the projector is ideal since it can be pulled out in front of the children’s cubbies, set in the middle of the room to separate the room into sections, or entirely closed up to use for another day.

**Competition**

Many other preschool spaces offer some sort of flexibility, but the type that we are going to propose will let teachers experiment with more types of technology and new, light-weight, durable furniture in order to convey the topics that the preschool class is learning about. Our design will integrate topics through projectors and new furniture that can be easily changed to move fluidly from topic to topic. This will be especially useful to play-based preschools that follow the interests of the children – and with shift in new "studies" should be a shift in the learning space. The competition provides for shelving, carpeting and other pieces of furniture that are movable and changeable, however, they do not recreate the space (and with as much ease) as our proposal of a super flexible design. Additionally, in many preschools, these pieces of small, movable furniture are either bolted down or hard to change (e.g. play set can only be changed once every year), making it difficult to really tailor the classroom design to the children’s interests.

**Typical Center Based Preschool**

A center based preschool is a preschool that stands alone and is not located within a family home. Within the typical center based preschool has shelving of different sizes and colors, shelving that is open on both sides and the usual “one-sided” shelving. As mentioned above,
shelving is typically difficult to move very often and in many cases shelving is bolted onto the floors of the classroom. In these particular cases, teachers are careful to plan their classrooms as it will be months before change can occur again. In many toddler classrooms, the furniture is easily moved, and smaller in size. This is typical since encouraging toddlers to explore new materials includes movement of furniture. However, these pieces of furniture are not stackable, and teachers are less likely to move them. These pieces tend to be longer in length than height, and perhaps provide less of a basis for creativity in the classroom, both on the part of the teacher and the student. This type of space does

Design Principles
We focused on the following design principles for our (re)design:

1. **Usability or ease of use** – as the audience of our learning space, which is a preschool classroom, is 2-4 year-old children, it is extremely important to keep the ambience, objects, and activities simple both in look and feel and in the mode of interaction.

2. **Flexibility** – to keep the children motivated by variations and modify the space based on the requirements of activities and other purposes, it is required to keep the space flexible by using movable furniture and other objects. The projection screen is also movable to provide more flexibility to the space.

3. **Prior knowledge of learners** – though the children in preschools are very young, they have substantial amount of prior experiences that act as scaffolds for future learning. Using simple objects such as colorful wooden blocks-type furniture and ambience such as forest and ocean would help every child to relate to and build on his/her prior knowledge and experiences or revise the concepts if required.

4. **Provide opportunities for learning** – we have provided a lot of learning opportunities in the space, such as marine life, forest, desert, and arctic atmosphere by projecting on a wall-sized screen. Chairs, cushions, and building blocks with pictures of animals, flowers, and other things help children gain new knowledge.

5. **Interactive** – as we believe that first hand experience is the best teacher, we have made the projection screen movable back and forth so that children can interact and play with the projection from both sides of the screen.

6. **Engaging** - the space and activities are very engaging and motivate the children to work and come up with different understandings and to produces different representations with the building blocks and projections.

7. **Use of media (physical and digital)** – we have used different media that is appropriate for various activities and styles of learning.

8. **Contextualization of activities** – incorporating real-world contexts in learning activities prepares children for identifying and solving real life problems.

9. **Universal access (accessible to those with disabilities)** – one of the most important and most overlooked design principles, universal access is required so that this space can serve children with physical disabilities. Everything in our room is movable and at a low height to enable every child to be a part in the activities. In addition, we have created a space that may be very simulating to young children, particularly those with attention deficit, sensory interpretation issues, autism or other disabilities. The moveable furniture and soft cushions function to accommodate the need for occasionally isolated spaces.

10. **Collaborative activities** – we believe that children learn by observing and learning from their peers and by taking part in activities with their peers and sharing their understanding of things with them.
11. **Coach/Mentor (real or virtual)** – a coach (in our case, the instructor) is required to guide the children in activities and provide them with feedback and opportunities to revise their theories and learn in new ways. We have provided a teacher space at the main entrance to the room from where the teacher can monitor every child in the classroom. We do not expect that the teacher will remain in this space for any significant amount of time while the children are present in the classroom; many children will demand their presence in other areas of the room. However, it was important for us to recognize that teachers spend time in the classroom beyond the school day and as such need a place that they can plan, assess, and meet with other staff members and parents.

12. **Opportunities to practice the learning** – practice helps children build a solid understanding of concepts; therefore, we have provided a space that allows for large scale models to be formed as well as the option to divide the space into smaller centers so that the same concept can be explored with multiple learning tools (books, blocks, clay/art supplies, water, sand, etc.)

13. **Motivating (challenge, curiosity, fantasy, learner control)** – we have provided teachers the opportunity to learn what motivates and inspires curiosity in their children and then develop a space around these factors. For example, a class fascinated with animals would be motivated to explore in a classroom that has been transformed into an African safari, complete with projected images of elephants in the wild. We have also built in challenge and control by allowing children the option to interact with these projections through shadow play, simultaneously reinforcing the concept of cause and effect. This space also gives teachers agency to shape their classroom experience, a motivating factor for many teachers who feel inhibited by spatial constraints. Motivating learning on the part of all users of the space was of critical importance to us.

14. **Multiple learning styles** – different children have different learning styles; some learn by watching or listening, while others learn by interacting with objects and each other. Children also have We have provided both audio and video projection as well as learning by watching images and reading the names of animals, flowers, and so forth.

15. **Feedback to reinforce, correct, and motivate** – instructors provide feedback to reinforce correct concepts and rectify mistakes by monitoring children from their seat.

**Challenges**
The main challenges faced by us were the following:

- Achieving a balance between the use of electronic media and physical objects.
- Though we were allowed to think in terms of unlimited budget for the design, we wanted our design to be practical, feasible, and financially viable.
- Though many more permanent learning activities could be incorporated, we were constrained by the space available in the room.
- In the absence of a prototype, we are not sure how the movable cube-like furniture would be used by the teachers effectively.

**Changes to the space**

1. **Movable shelves** – there will be movable shelves that teachers can move to change the layout of the room for various activities. The shelves are heavy enough so children cannot move them. These shelves can also store objects that are used in the classroom.

2. **Projection system** – the movable projector and screen will be used to project images and videos. The children can also play between two sheets of screens by interacting with the projection.
3. **Furniture** – the theme-colored chairs and tables will be used not only for seating but also for creating the ambience projected on the screen. Each chair has a picture and name of an animal or flower, which can be changed at regular intervals, thus creating a vast repository of information.

4. **Ambience** – the projection on the screen combined with the color of the tables and chairs create an ambience of ocean, forest, and so forth.

5. **Learning activities** – the building blocks provide the children an opportunity to be creative and build different objects. The cushions, which have letters and numbers printed on them can be used by children not only for resting, but also learning letters and numbers.

**Constraints of the space**
The one major constraint of the space is the teacher’s ability to take into consideration the ECERS-R (Early Childhood Environmental Rating Scale – Revised) every time there is change to the arrangement of the classroom. There are several areas in a classroom that should be accessible and available to children. To name a few: a quiet rest area where a child can rest where other children will not bother him/her, a soft and cushiony area (may be the same area, but does not have to be), and a “down and dirty” area where children can feel free to be messy or dirty.

Some of these areas can be easily taken into consideration every time the shelving is moved, or an area can be provided that is permanent and is not moved at all throughout the school year. A quiet, rest area is something that can be easily worked into the classroom so that it is a permanent space that will be undisturbed. However, maintaining a “down and dirty” area is more difficult since with the movement of the blocks means that there is movement within the materials that are going to be available in particular portions of the room. Additionally, in these areas where art materials are used, it is almost always suggested that it not be on top of carpeting. Our prototype does not include any carpeting on the floor, making the shelving more flexible in terms of where to put these “down and dirty” area, however, this means that softer areas in the room are confined to where cushions are provided or perhaps that permanent quiet, rest area.

Another concern that teachers must be able to deal with is the need to make smaller areas within the larger room. These smaller areas help prevent children from running across the room and becoming physically out of control. Some of the more innovative arrangements of the prototype room do not consider these elements of behavioral limits that furniture and space design help to create. But of course, we want to break some of the barriers of conventional preschool design, and a few innovative arrangements will not mean that children will be out of control for the rest of the year. Additionally, a few breaks in the long and cumbersome ECERS-R evaluation will not mean that the preschool classroom has failed as a teacher. In addition, though ECERS-R is a real constraint on classroom set-up and design, we recognize that it is not the ultimate evaluation of a successful space. Hopefully with mindful and creative teachers, the great degree of flexibility in this classroom arrangement will help children to better learn the new and interesting topics that they choose for themselves.

Additionally, the need for children to have a consistent schedule for their days in school is well documented in early childhood education research. However, we are not quite sure whether or not this consistency should be applied to space. This would have implications in the way that teachers would use this new found flexibility in the classroom. Unfortunately, the research on space and whether or not this consistency is necessary and beneficial to children is unknown. And even with materials matching up with different colored shelving, this may be too much for young children that have that need in consistency in terms of daily schedules, teachers, and expectations. But, this is something that can be worked around; children can be forewarned of changes, teachers can carefully plan how often changes should be made, and the material-color match of the shelving can be used as a learning opportunity for children.
Learning Activities
For a sampling of the learning activities that can occur within this space, please see the attached “user’s manual”. In this section, different classroom orientations have been highlighted and the possible activities that could be derived from the space are detailed.

Assessment
One of the most critical aspects of the design process is the act of assessing the success of the learning within the space. How will we know our design has been successful? In the case of the space we have proposed here, this is a particularly difficult task, compounded by the flexibility of the space. Users will have the opportunity to manipulate and change the space to suit the needs of the children and the teachers. We have taken a minimalist approach to this design, but this choice has not been without thoughtful consideration. We could have certainly designed a space that included state of the art equipment, expense playthings, and high-quality furniture, yet we chose to create a space in which success can happen in many ways. Thus the successful use of space will promote learning because the user has thoughtfully considered the needs of the learners and then manipulated the space to suit these needs. Once implemented, we would perform a qualitative investigation of the space as it is being used in order to see the ways in which the teachers are observing the students and manipulating the space to suit their needs. The sheer number of times that a teacher changes the space within a given time frame would not necessarily mean that the space is working successfully as intended, rather we would need to see evidence that the teacher was considering the needs and interests of the students in her decisions to move objects within the space.
User’s Manual

Though this classroom is in many ways similar to a traditional preschool classroom, to gain maximum benefit from the space and the objects within it, the user must be willing to critically look at the needs of the children within the space and arrange it for these needs. For example, a teacher of two year olds would find the need to rearrange the space less often in order to provide the children with a sense of continuity in care. Conversely, the teacher in a four year old classroom may be compelled to change the orientation of the space on a weekly basis to provide the children with new ways to look at the world. The following photographs represent different layouts for the movable furniture and suggested learning activities that could develop out of the depicted use of space. Users should not feel limited by these photographs and activities; this space was designed for creative teachers to manipulate it to serve the needs of their children and their class as a whole. Enjoy!

Option 1

In this set-up, the children are separated into spaces for multiple tasks. By using some cubes as dividers, the children gain a sense of being in an area that is intended for a specific purpose. For example, at the red table, children could be looking at books showing the birds of Africa and comparing them to the observed birds directly outside the window, while the children working within the purple cubes are exploring a small hut that represents the types of homes that some people in Africa live. The entire class is focused on gaining a better understanding of the continent of Africa, but their engagement with the material is different based on their location in the classroom. Small groupings allow children to interact with their peers without direct adult supervision. This arrangement also allows the teacher to work one-on-one with a child at her desk located in front of the wall map.
Option 2

Here the space is oriented towards whole-group direct instruction. Students are seated on the soft cushions and could be having a group conversation, viewing pictures or objects that represent the beginning of a new theme, or having morning circle time. If necessary, children can be separated from the group to work on individual tasks, or deescalate should they be over-stimulated by the environment. This space could also be used for physical activity that wouldn't be permissible in a traditional preschool space. Though we recommend that all children are able to enjoy the outdoors daily, weather does not always permit this, thus the need for a large, easily created space for energy release within the classroom. Note that chairs can be stacked to increase available space.
One of the most interesting features of this space is the inclusion of a projector and screen for use in transforming the space into another environment completely. Here the children as seated in an airplane configuration and preparing to view pictures of a faraway place that they’ll “visit” today. On the left, the teacher has set up the remaining furniture to represent a baggage claim. In this scenario, children are going to get to role play the experience of being in a plane as well as an airport and then see and interact with pictures from the location they’ll visit. Incorporated into a thematic curriculum on the location, this provides an authentic context for learning about new things and new places. In future, the screen could also provide the opportunity for children to take part in viewing of other children in distant regions of the world that they would not normally have the chance to interact with. The interaction could be fostered with the video-conferencing capabilities currently in use and development.