Science Learning in Playful Learning Environments: A Study from US Early Childhood Classrooms

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Abstract

Science may be a particularly vital subject in early life, serving not just to provide the foundation for future scientific understanding, but to expand understanding and recognition of the value of young children's thinking and learning. therefore, designing learning environment to support children's playful science learning is getting important. For this purpose, the current study was conducted to instigate how playful learning environments support children's science learning. The data of this study was collected from four different US early childhood learning environments. The analysis of the data showed that children's playful discoveries promote their scientific skills and science learning. In these learning environments, children are encouraged to play more and explore a variety of situations in these learning environments thanks to the materials chosen and the design of the learning centers that encourage interaction between children. The findings of the current study suggest that exemplary practices should be developed in order to move away from traditional learning environments and to support learning through play, and to raise awareness on this issue, starting with teacher candidates.

Keywords: Playful learning, science learning, playful learning environments

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Introduction

Piaget (1964) believes that play gives children numerous opportunity to engage with environmental components and construct their own knowledge. In recent years, there is a growing effort to bring back play into children's learning at school (Smith & Pellegrini, 2008). The related literature supports the idea that play and learning are mutually support one another (Buldu, 2022; Fisher et al., 2011; Kangas, 2010; Nicolopoulou et al., 2015; Zosh et al., 2018). What is meant by the term "playful learning" is that children can acquire knowledge while playing in their own free time while being guided by an adult or within the limits of a carefully designed game (NEAYC, 2022). Based on a review of the research literature, it can be suggested that learning through play is a learning pedagogy that includes developmentally appropriate practices. Research provides a strong support for our belief that children learn by means of the natural inquiry process of play (Whitebread et al., 2012).

To increase children's chances of developing their abilities on lifelong learners, they should be involved in meaningful discoveries through play (Zosh et al., 2017). For children's later success in math, science, language, and even social skills, it is important to meaningfully connect them to their needs, interests, and wonders. Through playful learning practices, children can try out their ideas, test their hypothesis, better understand social relations, and take meaningful risk for learning (Mardell et al., 2023). Providing learning process based on children's everyday life situations, and designing it through playful learning will help children to increase their ability of agency. Agency is basically the ability of children to consciously engage in their own learning. One of the main purpose of playful learning is to help learners on supporting their agency, creativity, and inquiry skills. It should not be forgotten that not all play is playful learning, and it is not something where anything goes. In playful learning, the content of the course is shaped around the learners' interests and wonders. Playful learning also does not mean that it is chaotic; rather, it has a purpose to bring about meaningful engagement in learning.

As to playful learning environment, it captures children's attention and maintains their interest, making even scientific concepts more accessible and enjoyable. When students are engaged, they are more likely to actively participate in the learning process and retain information better. In addition to the few studies on children's learning processes in well-designed environment, there are almost no studies that will reveal the relationship of playful learning environment with science learning in early childhood education. Therefore, the contribution of the study to the field will be great.

Playful Learning Environment

Children can explore their surroundings creatively while engaging in play. While playing they feel the pleasure of wonder and discover without limitations or outside interruptions. Play and learning studies conducted over the years show that open-ended and self-directed play and play environments are crucial for children's cognitive, social, and emotional development (Nicolopoulou et al., 2015). Thanks to playful interactions, it is possible to explore some of the most fundamental scientific problems through play. A playful learning environment is a place where children can deeply through their exploration, wonder, and, choices (PoP, 2022). One of the best aspects of playful learning environments is that children can lead their own learning in line with their interests and curiosity. In order to do so, to the extent that the literature leads us for creating a playful learning environment, designing semi-structured playful activities can help children to make spontaneous inquiries and discoveries (Kangas, 2010). Although there is no single way or understanding for the design of playful learning environments, an environment where children are supported to learn based on developmentally appropriate practices, and the learning process is fed with the information obtained from assessment results can be defined as a playful learning environment. A playful learning approach involves much more than just providing fun activities in the classroom. Children's feelings and mood for learning are key but not the only factor to implement it.

While designing the physical learning space, choices for material selection is one of the crucial elements that support children's learning. Open-ended, natural, aesthetic, novel materials are highly suggested for incorporating children's agency in their learning. Furthermore, creating a playful space in the classroom like a dramatic play area. Another important aspect to design a playful learning environment is to view the environment through the eyes of the children. Such questions like "Is the environment interesting? Inspiring?", and "Do they have the chance to cultivate their physical, cognitive, imaginal, and creative

abilities?" can help us to design playful learning environments (East Lothian Council, 2019). To think about how playful learning environments can be created within early childhood classrooms, the PoP team (2022) suggested four different lenses to create such environments; community, values, environment, and structure. Based on the "environment" aspect, it can be suggested that such learning environments provide a visible connection between children's lives and learning objectives. Allowing children for much flexibility in the use of classroom space and materials is quite suggested while constructing their knowledge throughout their learning process (Chaille & Britain, 2003). Movable and transformable materials can support your classrooms and children's changing needs.

Science Learning in Playful Learning Environments

Children naturally desire to learn about what is happening around them from the time they are born. Children are experts on play and also are scientists from birth (Chaille & Britain, 2003). It is critical to engage young children in hands-on playful learning (Hirsh-Pasek et al., 2022). Fostering their curiosity for deep science learning. For this reason, beginning in infancy, it is essential to provide children with an environment where they can discover and investigate as a part of their learning. such playful science learning environments require both inside and outside spaces for more inquiry and wonder. Science learning environments should be filled with the materials that children need for exploration (Bullard, 2010). It is well-recognized that children learn about things when they engage through their senses, and act out their interests (Berk, 2006). For instance, a child cannot learn about fragrances from a book. They become familiar with and learn about the smells of flowers, the voices of animals, and the textures of leaves by touching, smelling, and hearing them. By exposing children to experience things like seeing insects, establishing a setting where they can witness the seasons changing, and forcing them to feel the heat and cold, they will learn more quickly and effectively.

First of all, it is necessary to look at what the playful learning environment, where components are located indoors and outdoors, offers for learning. In the related literature, playful learning environments are defined as a place that offers a high amount of interaction and playful discoveries (Broadhead et al., 2010). For assessing the quality of physical learning environments, there are some checklists and scales that provide a deep understanding of how the environment can be designed around playful considerations and how teachers can support children's learning (Bjørnestad & Os, 2018). ITERS-R is one of the checklists that is used for rating environments. This scale suggests some quality indicators for classroom environments to support playful discoveries. Parallel with this understanding, this study investigated the four different early childhood classroom environments in the US to better understand how playful learning environments can be designed and support playful learning. Based on the purpose of the study, the research question of the current study is "*How does the design of a playful learning environment support children's science learning?"*

Method

The major purpose of the study is to reveal how playful learning environments support children's science learning skills. To investigate this research problem, the qualitative research method was chosen by the researcher. Basic qualitative research method was used for getting rich information about the learning settings. According to Creswell and Plano Clark (2011), one of the most effective part of qualitative study is to gather in-depth insight about the research problem. The data of the current study was collected through observations. To make systematic observation for the environments, the researcher developed an environment observation form that is specific to the research context.

Data Collection Contexts

The purpose of the current study is to get deeper information about how playful learning environments support children's science learning skills. For this purpose, a purposeful sample strategy was employed in the current study. To obtain information-rich cases for in-depth information, the teachers were selected from playful schools purposefully (Yıldırım & Şimşek, 2016). To this end, four different early childhood schools from toddler, preschool and kindergarten levels were taken part in the current study. All of the classroom environments included in the study were selected from Cambridge, MA.

The participant teachers in the selected schools work as partners in the same classroom. The toddler classroom environment was selected from one of the private school in the city. The kindergarten and

preschool classes were also selected from three different public schools. In the classrooms, the teachers work with their partners. The number of children in the class varies between 7 and 13. There are different learning centers in the classrooms and these centers are designed by the teacher. The size of the classes is designed in such a way that the children can move freely and the size is suitable for the class size. The schools are located in the center of the city and there are no big socio-economic differences among the children enrolled to these classrooms.

Data Collection Process and Tools

The researcher made observations after meeting with the schools to collect the data and determining the appropriate day and time interval. Before the observations, school principals and teachers were informed about the content of the study and ethical permission was shared. Observations were carried out in the spring term of 2021-2022. One day was allocated for each class observation and the observations continued until sufficient information was obtained for the observation tool. Each observation lasted an average of 2-3 hours.

The researcher developed an environment observation tool for observing each of the learning environment. The environment observation tool basically composed of three main parts; (1) Learning centers and materials, (2) Physical appearance of the classrooms, and (3) Integration of centers with learning.

The Environment Observation Tool was used ones at a time for each of the schools. The researcher took some notes about each of the categories. Each school was observed one time until reaching enough information about the learning environment. The purpose was not investigation of the interaction or teachers' practices, that's why one observation for each learning environment provided enough information. At the initial phase of the analysis, two theme developed; (1) learning environments and materials and (2) list of materials used on science teaching. However, it didn't seem like these two themes were different enough to be regarded as two separate themes. As is seen in the Table 1, there were four main factors to consider when using the observation tool.

Table 1.
An Environment Observation Tool

Dates/ The name of School	Organization of the learning environment	Physical appearance of the classrooms	Integration of the centers with learning

List of materials used on Science learning

After the initial version of the observation tool was developed, the researcher asked two experts in the field for getting feedback about the items in the tool. Both of the experts suggested to include separate place for list of materials used during science learning. After receiving all revisions, the researcher designed the observation tool from general appearance of the learning environment to integrating environment to learning process.

Before starting to the environment observation, the researcher contacted with the school administrators to observe physical appearance of the playful learning environments. Together with the administrators, the researcher visited the classrooms and filled the form. During the observation, the researcher did not focus on the teaching science. Instead of this, the researcher focused on how the environment support science teaching and learning in playful learning environments. The first observed learning environment was the toddler class. This classroom belongs to the one of the private school in the city center. The second classroom environment observed by the researcher was preschool classroom which belongs to

the public school. The other two kindergarten classroom environments were also belonging to the two different public school in the city center.

Data Analysis Process

To analyze how playful learning environments support children's science learning, the data of the current study collected through observations of different playful learning early childhood classroom. The collected data were analyzed through thematic analysis method as suggested by Braun & Clarke (2006).

Because thematic analysis enabled the researcher to more clearly identify common themes among the environments, thematic analysis was chosen to be the best possible analytical technique. As themes and codes were developed, this process was guided by the relevant literature (Bjørnestad & Os, 2018; Broadhead et al., 2010). At the initial phase of the analysis, two theme developed; (1) learning environments and materials and (2) list of materials used on science teaching. However, it didn't seem like these two themes were different enough to be regarded as two separate themes. After taking expert opinion for the data analysis, three major themes were developed: (1) Aesthetics of the space, (2) preferences for the learning materials, and (3) arrangement of the learning centers. As is seen in the Table 2, the analysis revealed that there are three major themes on the design of the playful science learning environments.

Table 2.
Major themes developed from the analysis

Aesthetics of the space	Preferences for the learning materials	Arrangement of the learning centers
- Wide and open windows - Bringing more green into the classroom - Less color, more function - Child-related displays	- Open-ended, natural, messy materials - Independent use of centers - Tools for connecting to the nature - Space for privacy	- Less segmentation btw areas - Encourage interaction btw children - Provocations to support scientific inquiry

Findings

The current study aimed to investigate playful learning environments to understand how these environments support children's science learning. For this purpose, four different learning environments were included in the study from toddler, preschool, and kindergarten levels. The analysis of the data showed that there are three major theme to uncover the support of playful learning environment for children's science learning. These major theme are (1) aesthetics of the space, (2) preferences for the learning materials, and (3) arrangement of the learning centers.

Aesthetics of the space

The first major theme developed for the current study is aesthetic appearance of the learning environment. Under this major theme, there are four categories;

- Wide and open windows
- Bringing more green into the classroom
- Less color, more function
- Child-related displays

For the first category of wide and open window is common for four different learning environments included in the current study. The lightening of the classrooms mostly provided through natural day lights. The classrooms have wide windows and doors to reach school backyards which are belonging to each class. Depending on the activity they are engaged with, children can easily reach out of the classroom or are not disconnected from the outside world with the help of wide windows. The other category showed that each of the classroom environment has plenty of green. The Reggio-inspired classrooms pay more attention to promote respect for both the natural and artificial environments. Therefore, children can both explore the growth of the plants and how to care them.

Another striking point in the classrooms is that the furniture is not very colourful and mostly wooden. These Reggio-inspired playful learning environment is a nontraditional place, and there are no seats for each of the children. Children can easily access to educational materials; thus they can take charge of their own learning responsibility. Keeping in mind that learning environments provides children with unique learning experiences, the environments were designed by considering to provoke children's learning.

The last category is related to how children's learning displayed in the classroom environment. For each of the classroom environments, displaying children's learning stories through documentations is crucial part of their learning process. The creative work of children is displayed all over the classroom and school, and it gives the strong impression that the learning environment was made specifically to foster children's imagination and curiosity. The walls of the classroom are filled with children's photos and quotations that belong to their learning process. In the Reggio-Inspired classrooms, the documentation emphasizes children's playful discoveries. Teachers carefully examine and record the content and aesthetics of the children's work as they observe and record it.

Preferences for the learning materials

The other major theme developed for the current study is preferences for the learning materials. Under this major theme, there are four categories;

- Open-ended, natural, messy materials
- Independent use of centers,
- Tools for connecting to the nature
- Space for privacy

For the playful learning environments, materials are decided based on children's interest and attention. Because the learning process is designed parallel with the project-based learning and the topic is selected based on children's desire and attention, open-ended natural materials are most commonly used materials in these environments. This is also connected with the other category of independent use of learning centers. As the learning materials are arranged in a way that attracts the attention of the children, the children can go to the centers individually and determine their own learning processes. Since the materials are open to exploration and do not usually have a single use, children spontaneously include the materials in their play. Materials like mud, piece of woods, shovels, pipes, sponges, pinecones, lights, leaves, sea shells are helpful for children to free play and playful discoveries. In these classes, children can use different type of materials for different purposes. For instance, the classrooms filled with letter visuals and literacy elements, so children can integrate them while even playing dramatic play.

The other attention grabbing features of the playful learning environments is the selection of tools for conducting learning activities. Unlike traditional learning environments where art materials —like crayons, papers, scissors, and sticks— are predominantly used, vagoons, tents, fireplace, light table, piece of woods are commonly used in the playful learning environments. the schools, which have not playground, can use some vagoons to take children to the natural environments. Therefore, the teachers can include different places into their learning process. The other benefits of using these tools is to create content through various modes. The teachers can design an activity for acting out the weather conditions, outside art, and free discoveries at the nature.

The current study showed that the playful learning enrolments in this study have some private spaces for children. These spaces can be designed in the book reading areas through cushion, dramatic play areas through cozy seats. Thanks to these spaces, children can spend some time for imaginative thinking.

Arrangement of the learning centers

The last theme of the current study is arrangement of the learning centers. Under this theme there are three categories as follows;

- Less segmentation between areas
- Encourage interaction between children
- Provocations to support scientific inquiry

Under the category of lees segmentation between areas showed that children can easily manage their own learning process and design their playful discoveries. In these classrooms, there is no specific learning centers like science, math or music as in the traditional classrooms. All areas are organized around the topic determined that day for the project, and anyone who wants can play in the area they want, specific to that topic. In relation to this category, the interaction between children engaging in different areas does not decrease. While a group is playing in one area, they can combine their play with other group, or one of the children can go to another area and continue his or her playing. Even though the space designated for each area is small, the intersection of the areas has an adequate amount of space where every child can play together. Children were allowed to choose what they want to do for play.

It is a part of environmental design to make the learning environment feel comfortable by arranging the materials on the tables and shelves in a way that will attract the attention of the children for playful learning environments. The children's environment was designed as being open and encourage play, discovery, learning, and creativity. Thanks to the design of the classroom, children can easily expand their knowledge by integrating different learning areas (for example, by adding writing or art to the science area). At each area and center, children can find some provocation questions to support their scientific inquiries.

Discussion, Conclusion, and Suggestions

The current study was aimed to investigate how playful learning environments support children's science learning. The analysis of the environments showed that each of the classroom have similar features and they are all designed by considering Reggio Emilia Approach. Based on the analysis of the data three major themes showed us how environment support children's scientific inquiry skills. The theme can be listed as; (1) aesthetics of the space, (2) preferences for the learning materials, and (3) arrangement of the learning centers.

The theme for aesthetics of the space showed that the aesthetic design of the classrooms is supported through Reggio Emilia Approach. According to Rinaldi (2005), Reggio approach takes into account three main factors that affect a child's learning process, also known as "*environment is the third teacher*". This is because it encourages children to pursue their interests, work together freely with other children, and acquire information from both inside- and outside-the-classroom activities (Cadwell, 2011; Fraser, 2006; Gandini, 2004). Parallel with the finding of the study, the related literature suggest that Reggio-inspired classrooms aims to provide a sensory learning environment to children thanks to its aesthetic design (Bullard, 2010). As it is presented in the current study, providing plenty of greens, easy access to the nature and the use of calmer and monochromatic furniture is common within these classrooms. According to Haworth et al. (2013), an effective science learning environment is one that fosters children's curiosity. For creating an effective playful science learning environment, thinking critically, and being deliberate while constructing an effective atmosphere in your future classroom are all necessary.

The other theme preferences for the learning materials showed that the classroom environments in the current study are different from the traditional ones. Instead of using art materials often for each of the activity, the materials for multi-purpose use are always preferred. These Reggio-inspired classes provide children with material support and the opportunity for long-term research projects. According to Rutter et al., 2001, the design of the science learning environment is profoundly important to enhance children's scientific inquiry skills. furthermore, studies frequently show that the classroom has an impact on student achievement (Haworth et al., 2013). To improve the quality or relevance of children's learning, there have been numerous attempts at changing the way science is taught (Aikenhead, 2006). One of the ways to achieve this is to change the materials offered to children. In this concern, it can be claimed that open-ended and natural materials will help children discover more, be curious and gain more experience. Children can use objects that are open-ended in a variety of ways. According to Worth (2010), Close investigation of materials is the foundation of inquiry-based science. Moreover, play is actively interacting with the materials we came across (Bogost, 2016). Parallel with these suggestions, it can be claimed that open-ended materials encourage creativity because they are about the investigating process. While children use unrestricted materials to make a certain kind of product, these products would reflect

the children's own discovery and ideas. Sand, water, blocks, play dough, paint, and other materials are some examples of open-ended materials. Through these materials children will learn a variety of topics through the discovery of materials. Parallel with the finding of the current study, Raven & Wenner (2022) also found similar findings. In their study, the researchers conducted single case study which focused on the activities and experiences of one constructivist-oriented preschool teacher who employed science-based guided play. The result of the study showed that arranging science learning centers and classroom environment is one of the important aspects of preschool science learning. similarly, the current study showed that arranging learning centers to support children's discovery, and inquiry is one of the elements that support children's science learning. The current study also showed that arrangement of the learning environment one of the effective ways of supporting children's scientific skills. According to finding of the Head Start study, as children spend much less time learning science than other subjects, they had poorer scores in scientific readiness than in every other subject (Greenfield et al., 2009). Children who are not given the opportunity to investigate science may develop knowledge and ability gaps that are rarely able to be filled (Morgan et al., 2016).

It is suggested that exemplary practices be developed to enhance learning through play and move away from traditional learning spaces. This awareness-raising effort should begin with teacher candidates. It is believed that in order for the concept of learning via play to be implemented into the educational system, it is crucial to prepare teachers with a playful mindset, beginning with teacher training programs. As suggested by Jorgensen, Schroder and Skovbjerg (2022), playful learning in higher education is an emergent field of research. The educator in Turkey may focus on how they can design more playful course content in higher education.

Acknowledgment

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