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***STEAM approach in teaching
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Mazkur uslubiy ko'rsatma umumta'lim maktablari, akademik lisey va kasb-hunar kollejlari o'qituvchilariga va malaka oshirish kursi tinglovchilariga mo'ljallangan bo'lib, o'kish ko'nikmalarini oshirish maksadida usullardan foydalanilgan.

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Introduction

This book has been written to help teachers to increase the pupils' language skills, STEAM stands for Science, Technology, Engineering, Art, and Math. Each of STEAM's five subjects share a common approach and focus. They require gathering and using evidence to create knowledge or solve problems. STEAM learning happens naturally everyday as children explore, play, and try new things.

When young children have the opportunity to investigate the world around them, they learn and experiment with new STEAM skills and theories. Research shows there is a positive relationship between early STEAM experiences and future success in school.

This document provides an interactive learning experience and is intended as a professional development resource to help supervisors, coordinators, managers, and education staff*understand how young children engage with STEAM concepts and ideas. This document will also help adults identify strategies for exploring and developing STEAM in early learning settings.

What is STEAM?

Children engage in STEAM everyday STEAM learning begins early. But STEAM isn't about showing an infant or toddler flashcards or teaching equations. It is the hands-on things that children do everyday.

STEAM learning includes examining shapes, building forts from cardboard boxes, playing "grocery store," pouring liquids and other materials, filling and emptying containers of different sizes, and mixing paints to create new colors. And these are only a few examples. Many of children's everyday activities use STEAM skills, even if we don't typically think of them in that way.

When children play, they explore and build skills and theories about the world. When young children investigate their environment, they experience the satisfaction that can come from investigation, discovery, and solving problems. Adults can foster children's development of STEAM skills by providing learning opportunities and materials that support exploration and discovery. Because STEAM activities are interactive, and exploration based, they provide many opportunities for children who are dual language learners to be actively involved.

S is for Science

Children are natural scientists. They try to figure out just how the world works by engaging in a series of steps called the scientific method. The scientific method includes observing, forming questions, making predictions, designing and carrying out experiments, and discussing. Even infants and toddlers are using a basic form of the scientific method (or performing little experiments) as they explore and discover the world around them!

Children find patterns and build theories to explain what they see, and collect "data" to test those theories. A theory is like a guess or possible explanation for something. A toddler makes footprints after she walks through a puddle. She may form a theory based on her observation of her footprints, that the way she walks changes the size and shape of the prints. She then tests her theory by hopping on one foot or walking on her toes to see if her prints change.

Like scientists, children learn from others. They watch what children and adults do and learn from trying to repeat what they've seen or by asking questions and seeing the results.

T is for Technology

When we think of technology, cell phones and computers often come to mind. But the "T" in technology also stands for any type of man-made object. Technology includes simple tools such as pulleys, wheels, levers, scissors, and ramps. They support children's cognitive development, because as children play with these tools, they observe and learn from the underlying cause and effect.

These simpler technologies allow children to understand how tools help us accomplish tasks.

Children can see the cause and effect behind them, like how adding wheels below a large object makes it easier to move, or how raising a ramp makes a ball roll faster.

E is for Engineering

Engineering applies science, math, and technology to solving problems. Engineering is using materials, designing, crafting, and building – it helps us understand how and why things work.

When children design and build with blocks or put together railroad tracks, they are acting as engineers. When children construct a fort of snow, pillows, or cardboard, they are solving structural problems. When they figure out how to pile sticks and rocks to block a stream of water or how objects fit together, they are engineering.

A is for Arts

A creative mindset is critical for STEM subjects. That is why the arts was added to STEM to become STEAM. Scientists, technology developers, engineers, and mathematicians need to innovate and solve problems creatively. The subjects in STEAM are similar in their approach to learning.

Active and self-guided discovery is core to the arts and to STEAM learning. Children engage in painting, pretend play, music, and drawing. Art is sensory exploration. Children can feel the paint on their fingers and see colors change the way paper looks. As they grow, children include symbols in their art that represent real objects, events, and feelings. Drawing and play-acting allow them to express what they know and feel,

even before they can read or write. Music is also linked to STEAM skills such as pattern recognition and numeration.

Research shows that early experience with creative arts supports cognitive development and increases self-esteem.

M is for Math

Math is number and operations, measurement, patterns, geometry and spatial sense. From birth until age five, children explore everyday mathematics, including informal knowledge of “more” and “less,” shape, size, sequencing, volume, and distance. Math is a tool children use every day!

Babies and toddlers learn early math concepts like geometry and spatial relationships when they explore new objects with their hands and mouths. Teaching staff support math learning with infants and toddlers by intentionally using math language throughout the day. They make math concepts visible when they connect them to objects and actions. Infants begin to understand the math concept “more” early on and often use it to signal they want more food or drink

At an early age

Children start using STEAM skills very early. When babies drop toys and learn that they fall down, they are beginning to learn about gravity. They grab objects and figure out that stuffed animals are soft and plastic cups are hard.

One-year-old children observe and experiment to learn physical rules, such as cause and effect, and they explore when they see something that violates those rules.

In one study, researchers showed babies a toy car roll off the side of a table and then hover in midair. Others saw the toy car rolling down a ramp right through a solid barrier. These are both things cars clearly cannot do!

Babies who saw the car hover in midair tended to drop the car, exploring the concept of gravity. Babies who saw the car go through the barrier tended to bang it against the table, exploring the concept of density.

We can spark children's natural interest in the unexpected by exposing them to novel materials and places and by letting them follow up on their own curiosity when they observe something unusual.

As children grow

As children grow, play becomes a bigger part of their lives. Exploration and hands-on learning naturally involve many STEAM skills.

One study found that during unstructured free play, four- and five-year-old children spent almost half of their time engaged in math-related activity.

Play often involves math language and thinking, even though math isn't the focus of their activity. Children talk about things like, "How much is a lot?" and "How little is little?" They often use their body to show size, such as stretching their arms to show how big a pumpkin is or holding fingers close together to show that something was "a little bit scary."

This early play with math ideas and concepts lay the foundation for the development of more complex math and science skills later on. Simply having time to play on their own gives children one way to begin to build the foundations they will need throughout their lives. Adults can play an important role in arranging the environment for play to make sure it is conducive for these STEAM explorations.

Children are motivated and persistent problem solvers

Children are naturally motivated to solve problems. When they have an active role in learning, they decide what they will do and learn from what happens.

When children are interested in an outcome, they create theories that they test and modify all on their own.

When children work on a task on their own, they experiment, correct mistakes, and develop strategies.

Researchers showed 2- to 4-year-olds a set of nested cups during a free play session. Later, they gave the children a chance to play with a set of separated cups and no instructions. Automatically, the children picked up the cups and worked hard to figure out how to nest them.

Executive function

When children direct their own exploration, they are also exercising other skills, like focusing their attention, motivation, decision making,

planning their behavior, and problem solving. These are all part of a set of skills that form the umbrella term “executive function.” Other executive function skills include switching between tasks, organization, self-control (regulating emotions and behavior), and memory.

Logical thinking

There are few instances in children’s lives where they see consistently predictable events or interactions. Sometimes the unexpected happens. Flipping a light switch usually results in a light turning on. But if the bulb is burned out, the switch doesn’t turn on the light. In fact, most events we observe as adults are somewhat unreliable: Cars don’t always start when you turn the key in the ignition, and hitting “send” on an email doesn’t always send the message if you’ve attached a file that is too large.

Children, too, must learn how to navigate a world that is not 100% reliable.

Luckily, they are quite flexible learners, which equips them with the ability to see patterns in all the “data” they collect about the world — no matter how inconsistent that data may be.

As children track these cause-and-effect relationships, they are quietly keeping a type of statistics. And they use this data to form theories about relationships that aren’t always reliable.

Supporting STEAM Learning

A great deal of STEAM learning happens during activities like free play, where children are given the opportunity to freely explore materials and make discoveries. Teaching staff can foster STEAM exploration during play and social interactions through the use of scaffolding. Scaffolding means offering the right support and structuring the environment to take a child’s knowledge to the next level. Just as a scaffold supports construction, adults can scaffold a child’s experience. To scaffold an experience, adults can provide assistance by cuing, prompting, questioning, modeling, discussing, and telling. By observing what children are doing, and then asking questions and working with them as they develop their own understanding of the world, adults can help walk them through increasingly complex ways of thinking. For children with special needs, scaffolding might include simplifying the activity by breaking it into smaller steps or reducing the number of steps in the task. A little guidance

can help children reinforce their knowledge, correct misconceptions, and extend their thinking. This helps them figure out even more than they manage to learn on their own.

For instance, children may enjoy watching a sand wheel spin as they pour sand through it. Yet they may not notice the connection between the amount of sand they pour and the speed the wheel turns. A question such as “How can you make the wheel go faster?” can help children notice this relationship and prompt further investigation.

Speaking the language

One of the best ways adults can support STEAM learning is with language. The language teaching staff use when they engage with children can encourage creative thinking, reflection, pretend play and problem solving. By observing, listening, and responding to children's interests, adults support their curiosity. When given the chance to communicate their thoughts and ideas, children develop their own thinking. Asking open-ended questions is an important way to guide a child's exploration. This can be useful for children of all ages — even infants can give non-verbal responses. Using props and/or engaging in the process while using new vocabulary helps young children, including those who are dual language learners, see the vocabulary in action. Descriptive observations are a great opportunity for all children to build their vocabulary. For example, "This rock is very hard." or "It feels bumpy."

The language of STEAM revolves around problem solving and the scientific method: observing, asking questions, making predictions, experimenting and discussing. It is important for teaching staff to model this process so that children become familiar with the steps involved in solving problems. This includes thinking out loud, and using STEAM language, such as "observe, explore, predict, experiment, etc.

Problem solving

Asking questions helps children reflect on what they are trying to do, whether it worked or not, and how to plan their next move. Listening to a child helps us learn where the child is in her thinking and helps extend her learning. It is helpful to adjust your questions for children who are dual language learners to meet their current levels of receptive and expressive English, and accept responses in the home language. This will support children in engaging and persisting when solving problems. These questions can be used with children of all ages.

Here are some useful questions to encourage problem solving:

- What are you working on?
- What do you notice?
- What did you try?
- What happened?
- What will you do next?

- What else could you try?
- What do you think will happen?
- What was different the second time?

Math concepts

Everyday language can make a big difference in a child's understanding of early math concepts. Here are some phrases and questions that help children think about math concepts in any of their activities.

When an adult asks, "Which one is bigger/smaller/heavier?" a child can measure, estimate, and describe.

"You have a big ball, and I have a small ball. Your ball is bigger than mine!" a toddler can analyze.

Other questions to ask:

- How many are there? (to compare or solve a problem)
- Which one is smaller?
- Which one is smallest?
- How often?

Children use math concepts frequently while they play. And it turns out that the more "math language" children hear daily, the greater the growth of their math knowledge.

Adults can increase math talk even in activities that aren't math-specific. During clean up time, model and encourage children to sort toys back into the correct bins. This supports classification skills. During snack or lunch, support geometry thinking by talking about the shapes of foods, such as,

"If I cut the sandwich like this, it will make two triangles."

- Other simple concepts include speed: "How fast will it go?"
- Distance: "How far is it?"
- Measurement: "Who stacked the most blocks?"

Creativity

Children come to the world with an open mind and may be more likely to think outside the box. A child's drawing might be a bird or a superhero or something else entirely.

Respond to children's work in a way that is not judgmental (e.g., "Nice work!"), but is objective and encourages children to describe what they've done:

- Tell me what you are working on.
- You made some interesting sounds with your shakers.
- Tell me about your drawing.
- I notice you used four different colors and filled the entire page.

This helps us learn what a child is thinking without making any judgment or assumption about her work. Answering open-ended questions also gives a child important practice communicating ideas through reflection, using narrative and descriptions.

Ask children scientific process or math questions to help them think creatively:

- What happens if you combine the two colors?
- How did you make that shape with your clay?
- What happens if you move your shaker really fast/really slow?
- How did you make that stand up?

Individualizing Instruction

A culture of inquiry includes all learners. In order to scaffold learning, first observe individual children. Next assess their understanding of concepts and ability to use materials.

Then change your instruction or environment to meet their individual needs.

Children who are dual language learners may understand STEAM concepts but need help developing the English vocabulary to talk about what they know. It can be helpful to pre-teach vocabulary using the STEAM tools and materials for exploration. This helps children to make connections between the objects and the English labels for those objects.

Allow children to speak in the language(s) in which they feel most comfortable to support curiosity and questioning. Also, visual supports can give children another way to communicate, instead of relying solely on verbal communication. This approach is appropriate for working with all children, including those learning more than one language or those who may have a language delay.

Additionally, it is important to adapt materials when necessary, to make sure that all children can participate as independently as possible. Some possible modifications include: reducing the number of steps in a task, placing the materials in positions that make them easier to access and use, providing adaptations to make tools easier to grasp, and making materials larger or brighter.

Activities to foster STEAM learning

STEAM really is all around us, ready to be discovered by our willing young explorers. We can:

- Be active and hands-on to encourage STEAM learning
- Learn about STEAM with our colleagues
- Help children learn and explore STEAM concepts

Setting the stage to foster STEAM

Use materials that engage the senses: textures, smells, tastes, sounds, and sight. Allow children to taste test and compare foods. Ask which is crunchier, sweeter, or smoother. Combine science and art by having children paint different surfaces with the same color, and then compare their appearance.

Design activities that ask children key questions:

Counting, measuring, and weighing help with number familiarity. Examples might include, putting items in sequence, identifying the steps in a process, or putting objects in order by size or weight.

Play games that use executive function: simple clapping patterns and rhymes, sorting tasks, or motion games like Simon Says.

Speak STEAM: Incorporate problem solving and math rich language in all types of activities. Listen to children's observations and provide scaffolds when appropriate.

Explore the outdoors and nature: Encourage creative and active exploration outdoors. Ask questions about colors, shapes, and textures. Compare and contrast things you can touch and feel.

Read fiction and non-fiction books with STEAM-related content: Literature provides a great springboard for discussion and activities.

Schedule open-ended and extended time:

Children need time to become fully engaged in exploration and investigation. Older children may need several days or even weeks to fully explore some concepts

Everyday materials that support STEAM thinking

- Balls
- Books
- Role-play materials
- 2- and 3-dimensional shapes
- Blocks
- Building sets
- Pulleys
- Wheels
- Levers
- Ramps
- Cardboard
- Clay
- Paints/watercolors

- Scissors
- Rulers/measuring tapes
- Tubes, funnels, sifters
- Sand/water
- Snow/ice
- Magnifying glasses
- Sticks and rocks
- Plants
- Stamps and stamp pads

Everyday language that supports STEAM thinking

Observe

- What do you see?
- What do you hear?
- How do they sound and smell?
- How are they the same?
- How are they different?
- What happens when you try?
- You seem curious about...

Question

- What are you curious about?
- What do you want to know?
- Are you wondering if...?

Predict

- What do you think will happen?

- What are your predictions?
- Why do you think that?
- How could we find out?

Explore/Experiment

- Let's investigate.
- What do you notice?
- What is changing?
- What did you try?
- Let's draw what we see.

Discuss

- What were your predictions?
- What happened?
- What did you notice?
- Why do you think that happened?
- What could we investigate next

STEAM in books and reading

Create groups of three-four adults or find a mentor or partner who shares a similar role to have a discussion. This is also an activity that could be used by a coach with an individual teacher or learning community.

- Do you have a favorite children's book that is STEAM related?
- Why is it a favorite?
- What STEAM topics are included in the book?

Topics could be sequences, numbers, experimenting, building, or any other STEAM topic. For example, in *The Very Hungry Caterpillar*, there are numbers, counting, and size. In *Mike Mulligan and His Steam Shovel* there are concepts like how much, how big, and cause and effect

Finding STEAM in poems and songs

Poems and songs can go along with STEAM exploration. They can expand

thinking and vocabulary, and expose children to new words. They can be subtle

poems that allow thought and discovery. Here is one that lends itself to STEAM related discussions.

1. In small groups, have one person read or sing the poem "The Little Turtle."

2. Now, with your group consider these questions and share different answers.

Can you think of STEAM concepts related to the words and actions in this

poem? Possible responses: ponds, animals, insects, sizes of animals, what

animals eat, predators and prey.

What STEAM questions or activities could you create to go with this poem?

Possible responses: What's a minnow? Flea? Who has had mosquito bites? Why

did the turtle live in a box? Where do turtles live? Why couldn't he catch me?

Visiting a pond

"The Little Turtle"

There was a little turtle.

He lived in a box.
He swam in a puddle.
He climbed on the rocks.
He snapped at a mosquito.
He snapped at a flea.
He snapped at a minnow.
And he snapped at me.
He caught the mosquito.
He caught the flea.
He caught the minnow.
But he didn't catch me.
– Vachel Lindsay (1923)

When to scaffold and when to let children explore

Scaffolding is a balance. If we don't offer enough help, the child can struggle and become frustrated and give up. But if we offer too much help, the child is missing out on an opportunity to stretch his learning.

And sometimes, it is best for a child to explore with no scaffolding at all. To find the “just right” spot, we have to pay attention to what the child is doing to decide how much support to offer. With a teaching partner or teaching team, think about STEAM activities in which an adult needs to provide scaffolding.

Now consider STEAM activities when adults don't need to provide scaffolding and should let children explore on their own. With a teaching partner or teaching team, explore all of the answers you can come up with. (For example: playing make believe or an infant exploring objects with his mouth.)

As a group, try to think of the many ways that you can facilitate children's STEAM exploration. (This could include providing materials for children to discover or try something, or adding new elements to their play. You might put yourself at the same level of knowledge as the child, etc.

Creative thinking

Children come to the world with an open mind — their brains are primed to explore and learn.

They naturally “think outside the box” because their thinking hasn’t been “boxed” by experience yet.

1. For this activity, on separate pieces of paper, write down four or five everyday objects you might find in a classroom (such as small paper cups, pencils, craft sticks, pom poms, and spoons).

2. Divide into small groups of two or three.

Make sure each small group has one piece of paper with one object written on it.

3. In two minutes, think of as many creative uses for the object as you can.

4. Then share the different uses for each object with the larger group, and together select the most creative uses for one of the objects.

Instructions for trainers

After the teams are done, ask the groups:

- How many of you only listed ways that you have actually used the object?

- How many listed ways to use the items that you have never used before?

- How many of you were surprised by the creativity?

- How many ideas were truly “out of the box?”

- How many other ways do you think preschool children might come up with to use your object?

- With less background knowledge, preschool children seem to have limitless ideas and will think of dozens of other ways to use the objects.

- As adults it is important to take care and try not to impose too many of your own ideas before children have had the chance to explore.

STEAM is all around us

Nature provides one of the best environments for spontaneous exploration, play, and learning. A park, a field, the sidewalk outside your building — any outdoor space works! Unstructured playtime in the natural world contributes to STEAM learning in many ways.

Direct experience with the natural world provides opportunities for problem solving and observation. The outdoors provides a wide variety of

sensory experiences. This encourages informal learning as children explore and make discoveries.

- Observe different textures, smells, and sounds.
- Compare living and non-living things.

The diverse materials found outdoors can facilitate imaginative play.

Gardening indoors or outdoors helps children learn about the natural world, and lets children practice math, science, and engineering in a hands-on way.

- Bringing natural materials inside allows for continued exploration and discovery.
- Plants, stones, and sticks can be used to count, build, and create.

Nature provides opportunities for STEAM learning

- Investigate shadows, the wind, weather.
- Observe plants, insects, birds, and other animals.
- Feel the wind and watch how it moves objects like leaves or paper.
- See changes created by sunlight on surfaces.
- Experiment with shadows and reflections.
- Listen for sounds in an “outdoor concert”; determine if the noises are from nature or from the city.

• On a neighborhood walk, children can answer the question “What lives in our neighborhood?” and create maps of the area when they return.

- Describe and draw or count the kinds of clouds they see.
- Draw pictures of what seeds will look like when they grow.
- Choose what and where to plant something.
- Ask how many beans, clouds, flowers they see.
- Ask children to point to the bigger or smaller plant.
- Ask them to compare, classify, make predictions, and form theories

STEAM in books

Both fiction and non-fiction books offer a way to introduce and discuss the complete range of STEAM topics. Shared book reading is also a way to expose infants and toddlers to different shapes, colors, letters, and patterns. You can use books to make connections to the real world and

children's experiences. For instance, when reading a book about a bunny rabbit to a group of infants and toddlers, point out a picture of a bunny in the room and/or talk about the bunny they saw outside on a walk. Books can draw students in and act as a springboard for STEAM activities.

Studies have shown that books encourage interest in science in the early years. Books also boost children's science vocabulary and that can prompt children to ask questions about their environment. Children like to surprise us by identifying dinosaurs or construction equipment by name.

Noticing the different characteristics of these objects is a STEAM skill.

Shared book reading is a way for adults to draw attention to STEAM vocabulary and concepts. It lets children ask questions and make predictions. Adults can engage children by asking questions and allowing them to make comments.

Research shows that asking open-ended questions while reading aloud (rather than after) is most effective.

When working with children who are dual language learners, provide non-fiction books in their home language, whenever possible. Learn some of the key words and phrases in the children's home language(s). Use real objects, photographs and/or illustrations to support children in acquiring the English words for key vocabulary and concepts.

Choosing the right STEAM books

Almost any book can be related to STEAM and you can start a discussion:

- What do you notice about the two trees?
- How many are in the pot?
- What do you think will happen?

There are several things to consider when selecting STEAM-related books for young children:

- Is it fun to read?
- Do you like it? Do you think the children will like it?
- Are the language and illustrations interesting?
- Is it captivating — a good story?

- Is the book available in the language(s) spoken by the children?

Consider if the book matches the child’s developmental level and interests.

Look for books so children see characters of different sexes, races, and cultures engaged in STEAM-related activities.

STEAM is for everyone.

If you are selecting a non-fiction STEAM book, look for current, accurate content with clear explanations.

- Does the book contain misconceptions?
- Is it up to date?
- Does the story promote a positive attitude toward science?
- Does it make STEAM fun?

Games to build executive function skills

“Head, Shoulders, Knees, and Toes” variations

Most of you know this game. As you sing the song, you touch your head, shoulders, knees, and toes that correspond to the words in the song.

After you play the regular way, switch the rules. Now, when the song says “head,” touch your toes and when it says “toes,” touch your head. To make it even more complicated, switch shoulders and knees too. Researchers asked children to play this same game to measure their executive function skills including:

Inhibitory control

A child must inhibit (or stop) the dominant (strongest) response and do the opposite of what the adult says. Working memory A child must remember the rules of the game.

Focused attention

A child must focus attention on the directions being presented by the adult. A recent study found that how well children did on this game in prekindergarten predicted growth in mathematics, and in kindergarten it predicted growth in all academic outcomes. Executive function skills support not only children’s STEAM learning but all learning.

Other well-known games that promote executive function skills

Peek-a-boo, Simon Says, and Red-Light/Green Light are good ways to develop executive function skills and are effective playful learning.

Peek-a-boo helps infants use their working memory skills to remember who is hiding, and practice self-control to wait for the person to reveal herself. Simon Says and Red-Light/ Green Light require older children to follow directions, pay close attention, and exercise restraint.

Playing with blocks allows children of all ages to build executive function skills.

- Children use engineering skills when they balance and put blocks together.

- Infants focus attention as they attempt to bang blocks together or stack just two blocks.

- Older children focus attention as they build complex structures to create symmetry and build arches and make sure not to knock them over.

- A child uses working memory to think about what pieces worked best the last time.

- Children practice cognitive flexibility and problem solving when deciding on the next piece to use. For example, if there are no big pieces left, the child has to adapt and use a combination of smaller pieces instead

Conclusion

This book includes a lot of information. Both fiction and non-fiction books offer a way to introduce and discuss the complete range of STEAM topics. Shared book reading is also a way to expose infants and toddlers to different shapes, colors, letters, and patterns. You can use books to make connections to the real world and children's experiences. For instance, when reading a book about a bunny rabbit to a group of infants and toddlers, point out a picture of a bunny in the room and/or talk about the bunny they saw outside on a walk. Books can draw students in and act as a springboard for STEAM activities.

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STEAM approach in teaching foreign languages
Umumta'lim va kasb- hunar ingliz tili o'qituvchilari hamda
malaka oshirish kursi tinglovchilari uchun uslubiy ko'llanma.

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