

Speech Blubs Educational Games

An Introduction to Speech Blubs' Newest Games



Speech Blubs
Helping Kids Speak!

TABLE OF CONTENTS	1
PART 1: Meet the Games	2
PART 2: Behind the Games	53
Proof of Concept	53
Who is the app for?	53
What do games do for them?	53
Exposure to words	53
Positive language learning association	55
Digital Literacy Skills	56
Cause-and-effect relationships	59
Smart Screen Time	61
Fine Motor Skills	62
Emphasis on digital literacy and hand skills for touch screens	62
Vocabulary Expansion	63
Ludic Learning	64
Learning Through Song	65
PART 3: Metrics	66
PART 4: The Future of Speech Blubs Educational Games	68
Works referenced:	70

PART 1: Meet the Games

Puzzle Game



Few games nurture such a broad range of skills as this beloved classic! The goal is to improve the child's problem-solving skills, develop an understanding of shapes, learn to recognize similar colors, and build a strong foundation for future academic success.

Children will also get familiar with a variety of different objects as the game is separated into three major sections:

- Groceries (Cookie, Broccoli, Ice cream, Banana, Cheese, Juice, Eggs, and Soda)
- Animals (Cat, Dog, Pig, Frog, Bear, Bunny, Monkey, and Giraffe)
- Transport (Car, Airplane, Bus, Boat, Rocket, Train, Tractor, and Submarine)



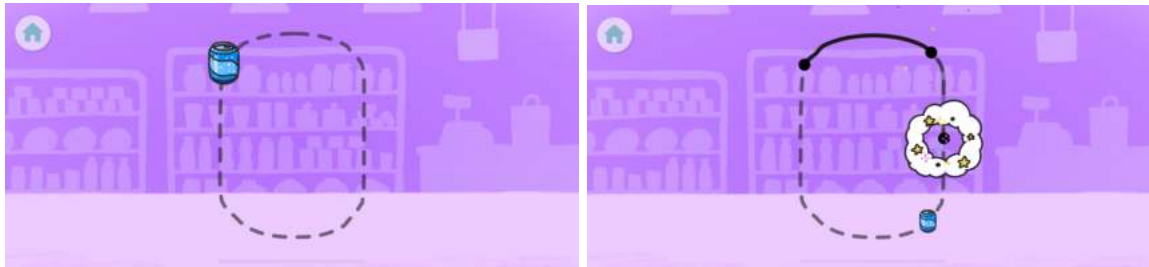
The puzzle game consists of three educational levels a child must finish to complete the lesson.

1. Connecting the dots
2. Coloring

3. Puzzle

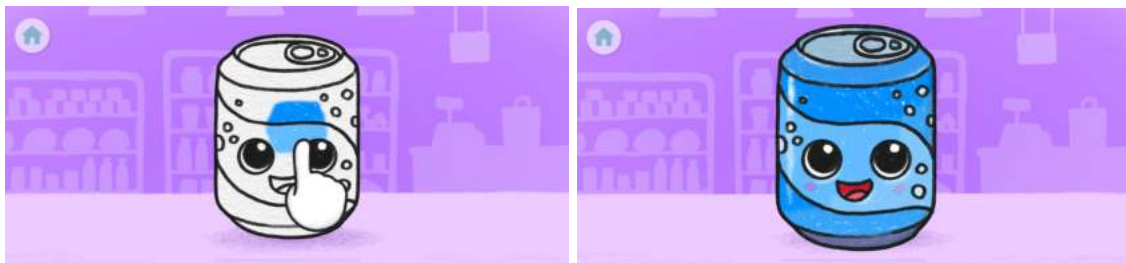
1. Connecting the dots

Once the child chooses a lesson (picks the object), the first level begins. Here the idea is to connect all the dots to create the object's shape.



2. Coloring

In the second level, we focus on coloring the object we have just created. The child swipes across the screen and the specific object to color it and bring it to life.



3. Puzzle

In the final stage, the object we have just colored will break into two pieces and create a simple puzzle. The child is now expected to press and drag each of the pieces of the puzzle in the center and create a complete puzzle. The puzzle is forgiving, so children do not need to deal with overly-demanding precision.



Cooking Game



Children love spending time with their parents in the kitchen, exploring ingredients, getting their hands dirty, and cooking! We wanted to replicate a real-life activity children love and make a game out of it. Another way to think of the game is like a digital play kitchen for children.

Using creativity and problem-solving skills, the child will cook a tasty meal for Lily the Pig. They will learn the names of typical food items, understand the fundamentals of combining and cooking, as well as cause-and-effect. Through these exercises, they will also gain exposure to domain-specific vocabulary and reinforce existing culinary vocabulary, while being surrounded by common words.





The child will have four meals from which they can choose:

- Tacos
- Cupcake
- Pie
- Pizza
- Burger
- Pancakes
- Hot Dog
- Curry

The idea is to prepare a meal in four steps to complete the lesson.

1. Identifying and combining the ingredients
2. Cook/bake the meal
3. Decorate/finish the meal and the plate to their liking
4. Feeding time

1. Mixing the ingredients

Depending on the meal, the child will be presented with all the ingredients necessary to prepare the meal. The game will then ask the child to engage each ingredient by selecting and dropping each one into a mixing bowl. Every action triggers the voiceover for the

ingredient dragged. After successfully adding all the ingredients, the game will advance to the next stage: cooking.







2. Cook/bake the meal

In the second level, the child is prompted to cook the mixed ingredients by putting them in the oven. This is done by dragging and dropping the preparation into the oven. This process helps children understand the multi-step process of food preparation, including what an oven does, how food can be transformed by various processes, and what it is their caregivers do every day to give them the yummy nutrients they need to grow.





3. Decoration

After the meal has been prepared, it is up to the child to decorate it. They will be presented with various decorations and fixins that they can drag and drop on to the meal to finish preparing it. Every action also triggers the word voiceover for each decoration. This is done to introduce another element to the food preparation, as well as let individual creativity shine! This section is a lot more flexible, with no “right” answer requires to advance, so it really promotes a child’s individual tastes and preferences to flourish.

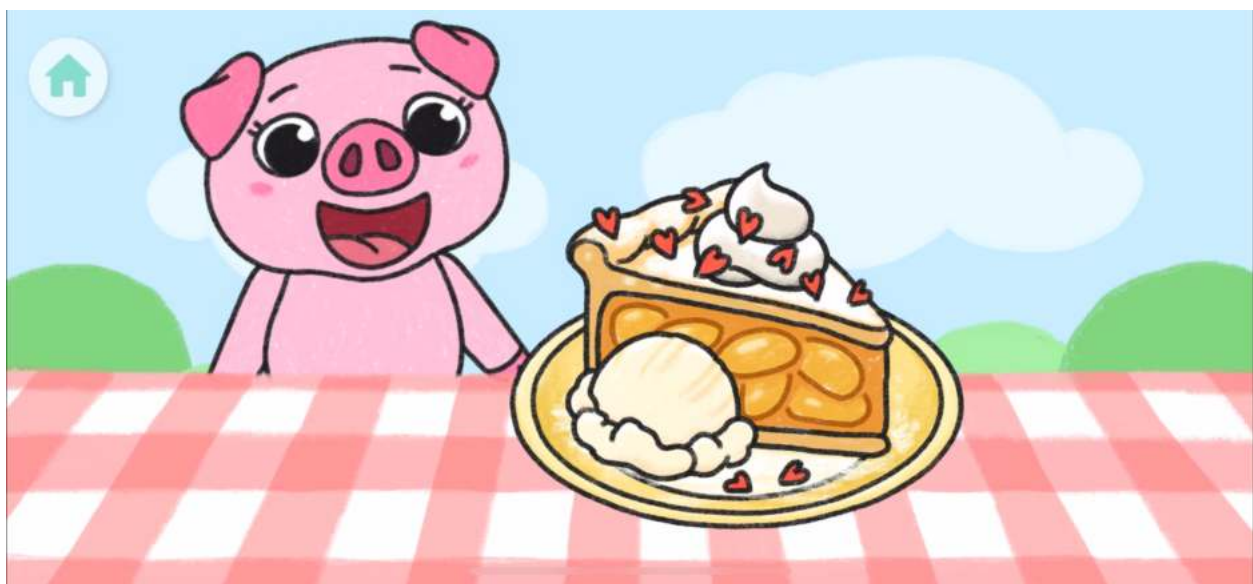
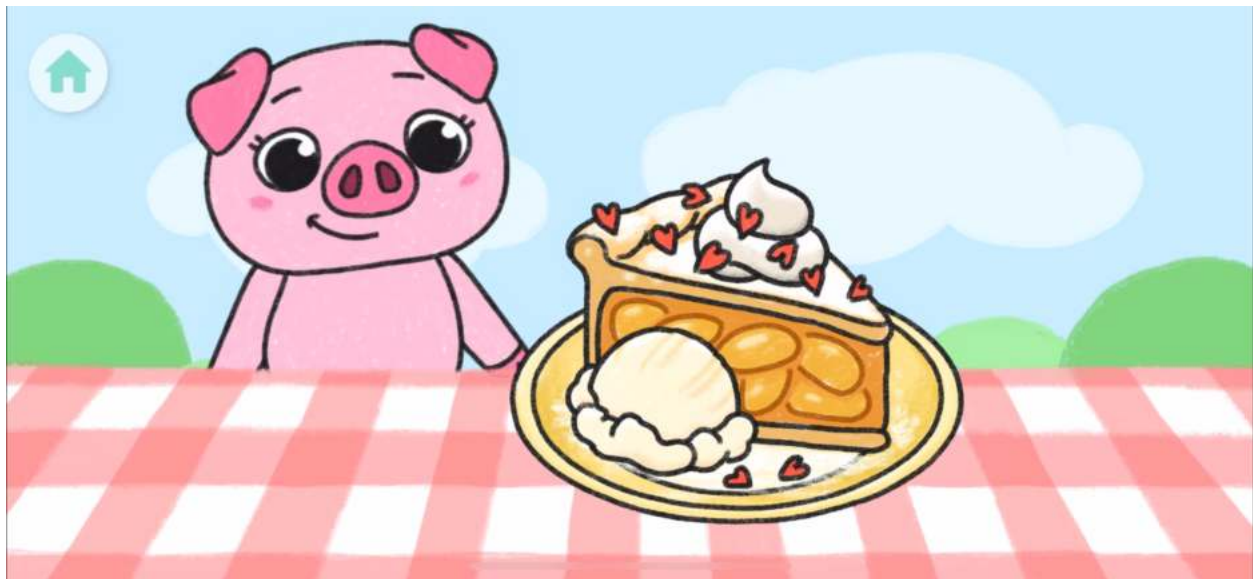


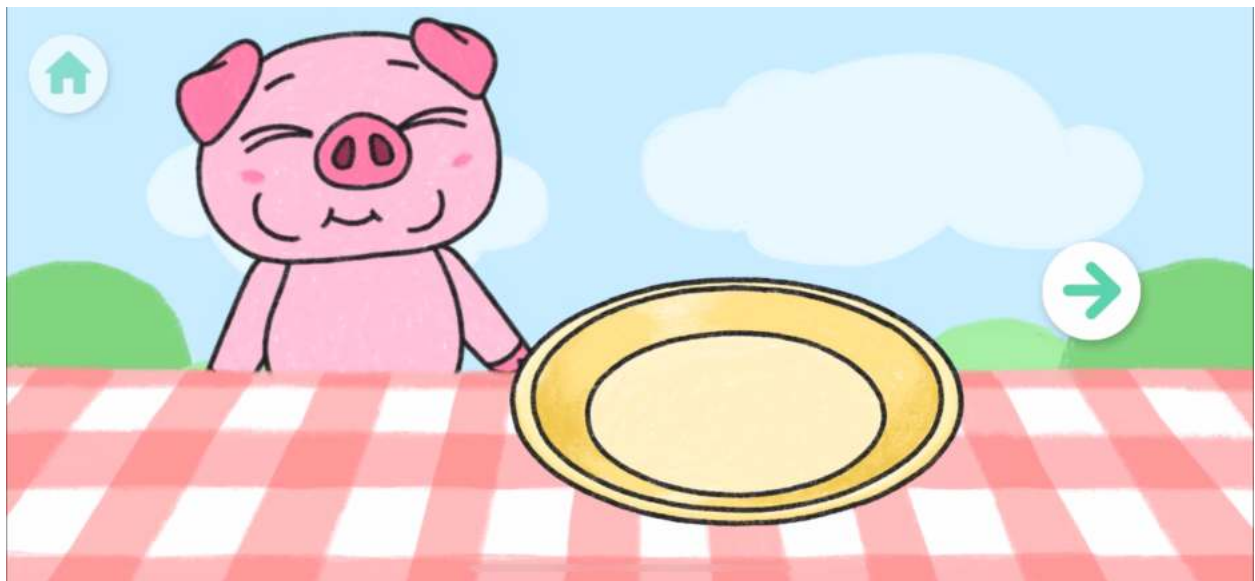




4. Feeding time

After the meal has been prepared, it is time to feed Lily the Pig. Children drag the meal into Lily's mouth, whereupon she eats it, and compliments them on their preparation. They press the meal and drag it to Lily's mouth so she can eat it! This section teaches sharing and promotes a healthy relationship with food, all while positively reinforcing the children on new skills.







Shapes Game



Recognizing the shapes is essential for children to learn letters and numbers, as well as establish a baseline for spatial awareness and reasoning. In the Shapes Game, the child will learn about a number of shapes, develop skills for organizing visual information, and improve their hand-eye coordination.

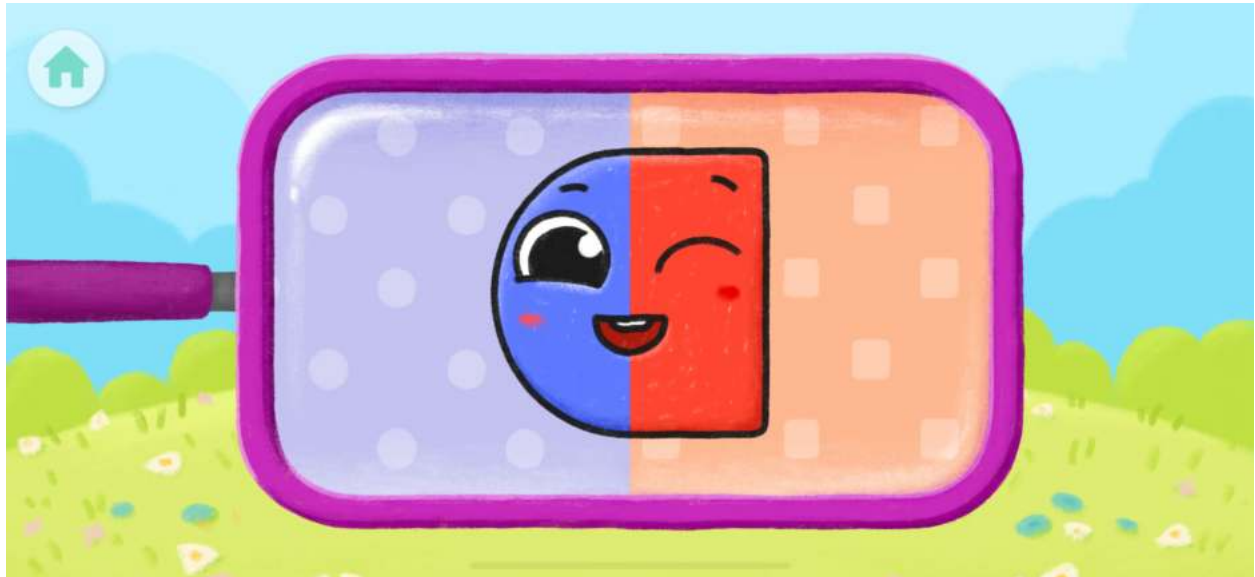
The game has a simple premise; the shapes are split into pieces and the child needs to consider the divisions, and match the shapes with their corresponding halves. At the end, they are rewarded with a unique shape-themed video.

The game consists of three levels. The first two levels require active participation from the child, and the final level is a unique shape-themed video.

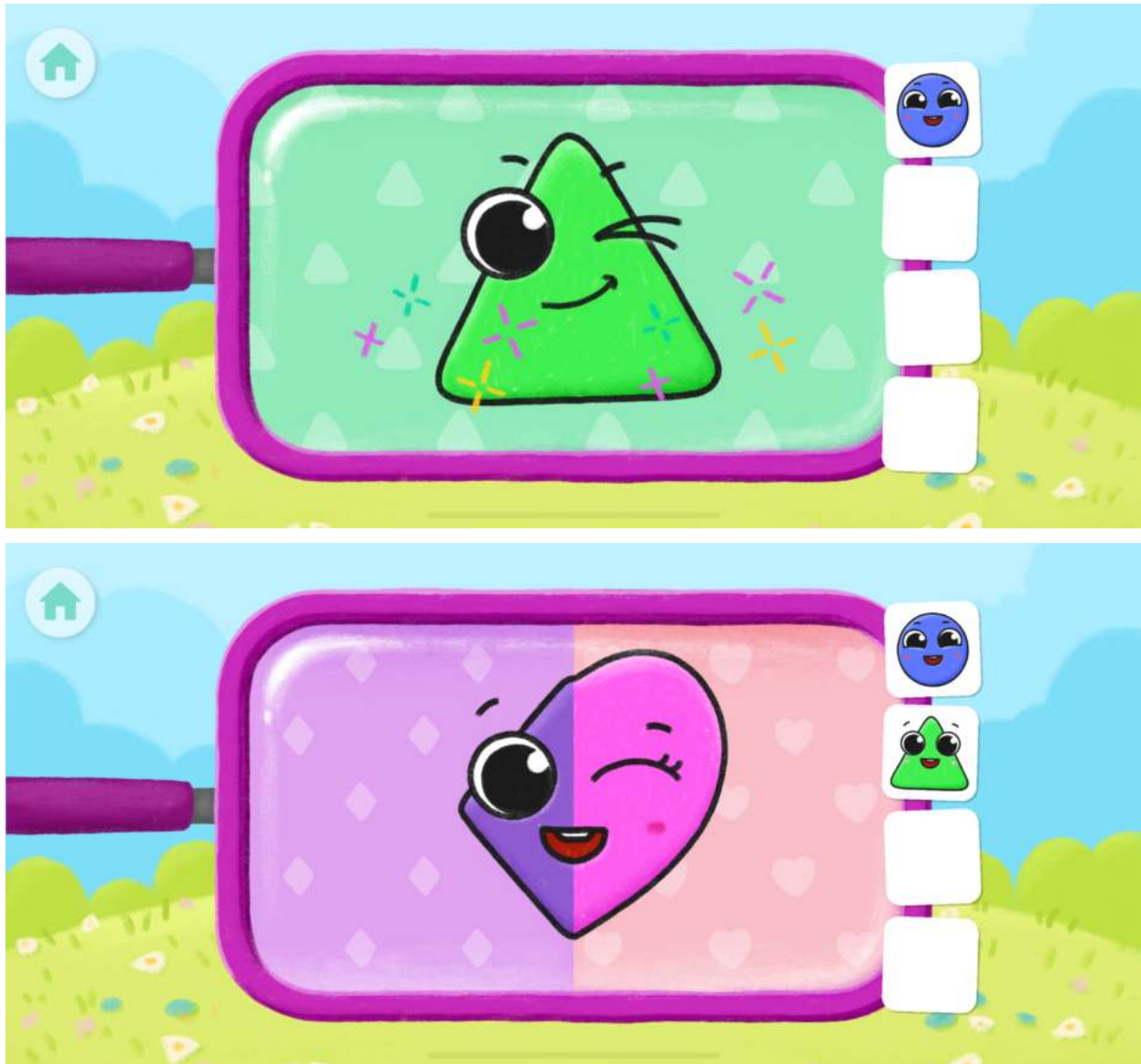
1. Matching the shape (slot game mechanic)
2. Memory game
3. Unique shape-themed video

1. Matching the shape

In the first level, the child will be presented with a screen split in half, on which they can scroll through different shapes on both sides. The idea is to find a matching pair to complete a shape. The child then has to collect four shapes to advance to the next stage. The child can freely swipe up and down until they find a match. After the shape is found, a voiceover will identify the shape.

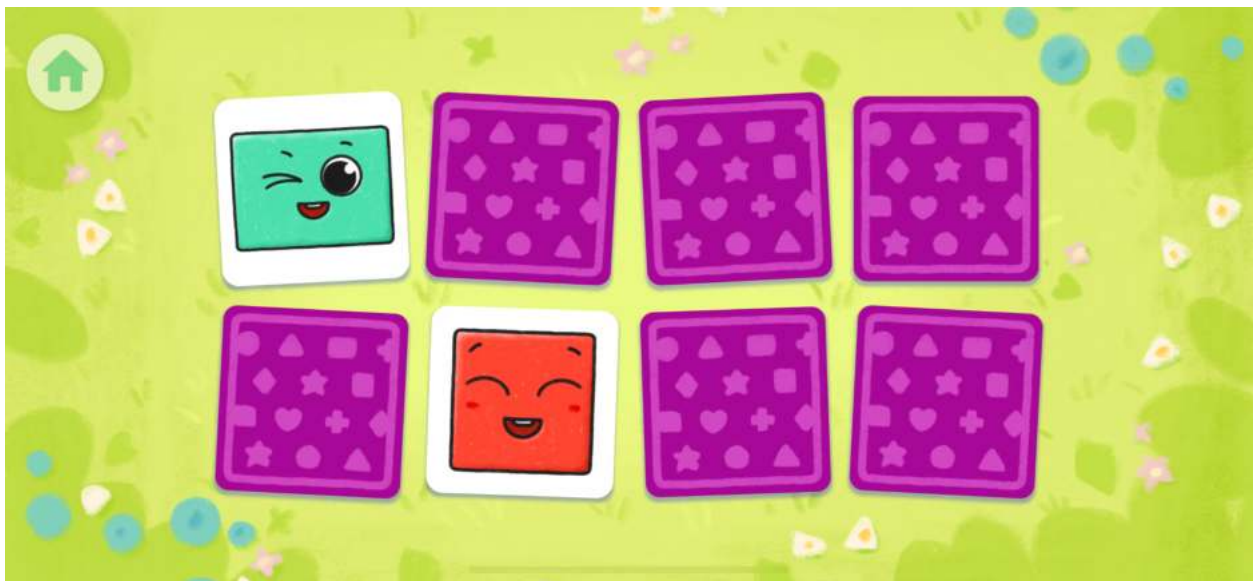


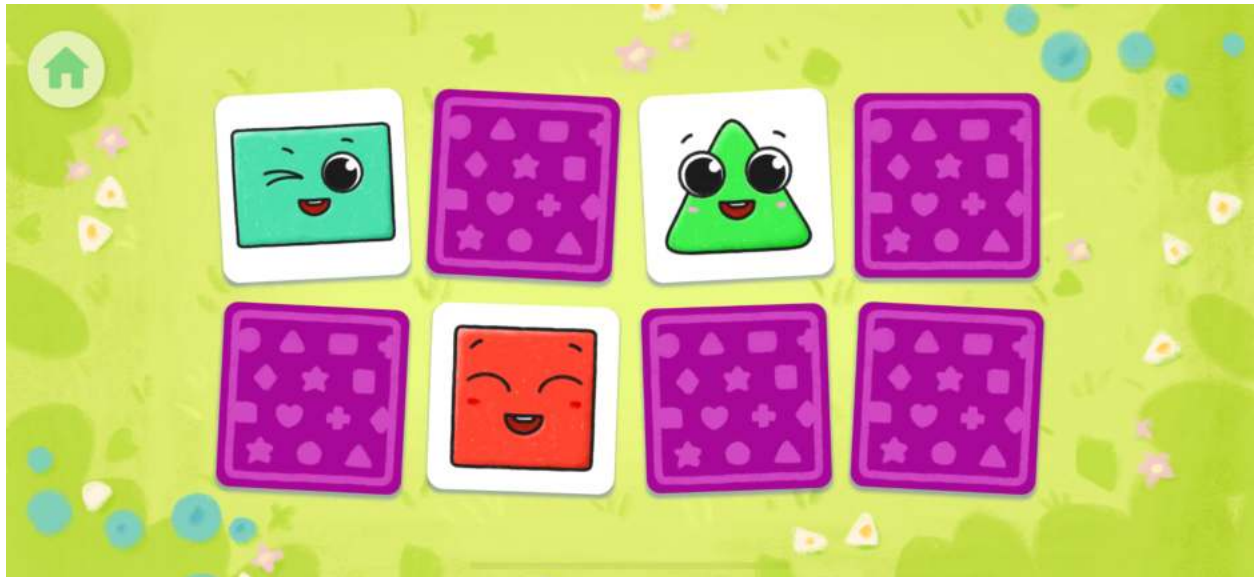


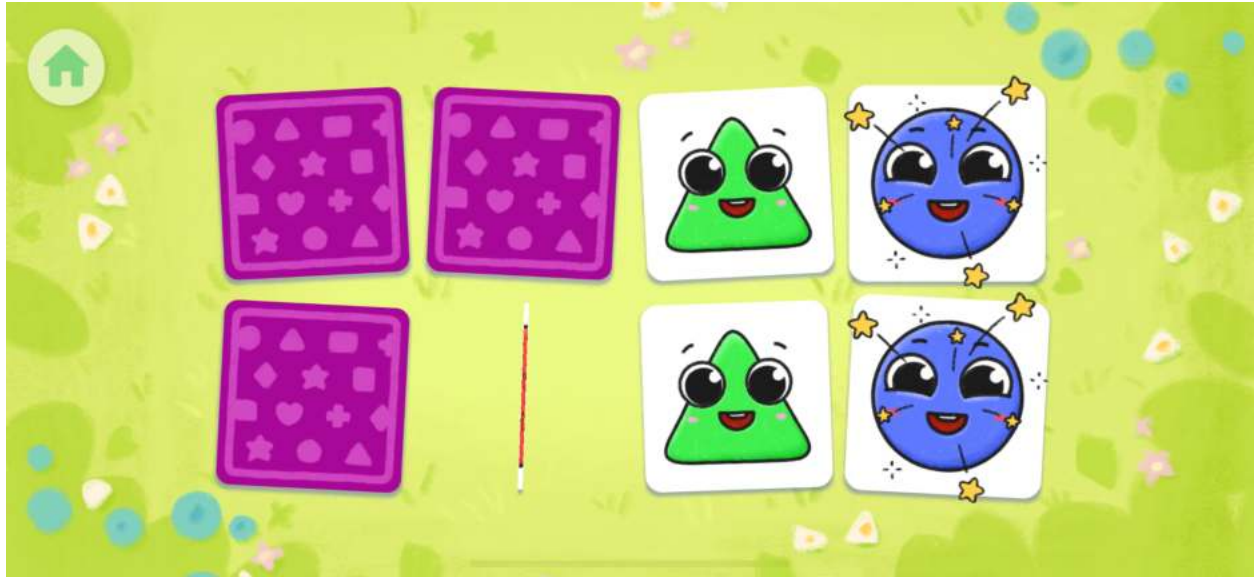


2. Memory game

After the child matches four shapes, they are presented with a classic memory game. The game consists of eight tiles, concealing four pairs of matching shapes. Unlike the “grownup” version of the game, here, a child can open cards until they find a match (they don’t close if they pick wrong). This stage also includes voiceovers of the shapes.





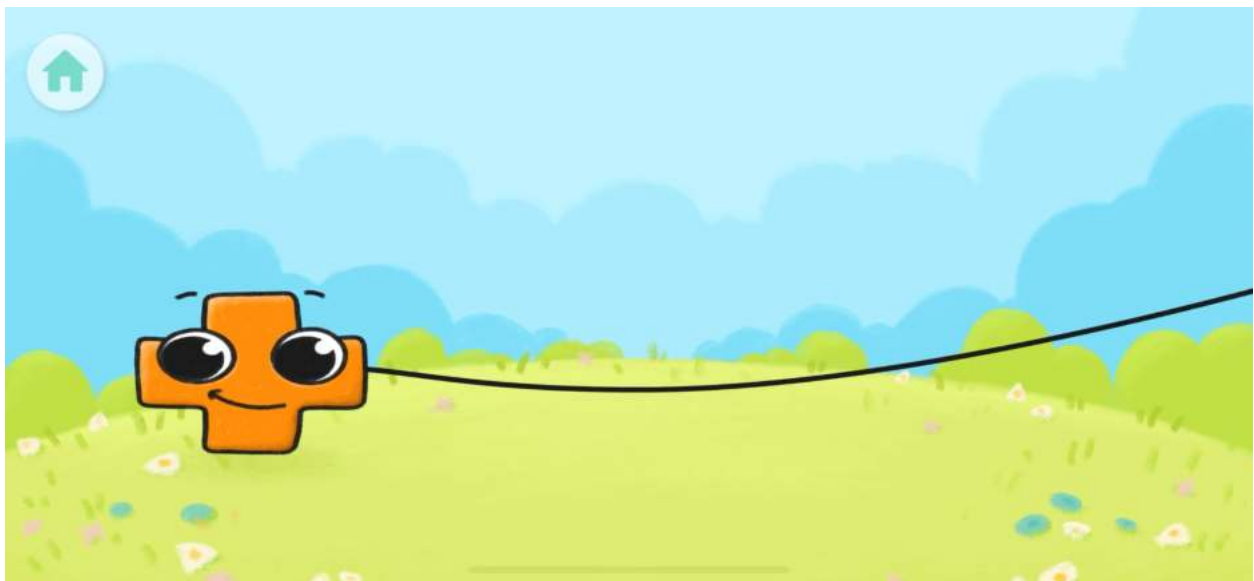


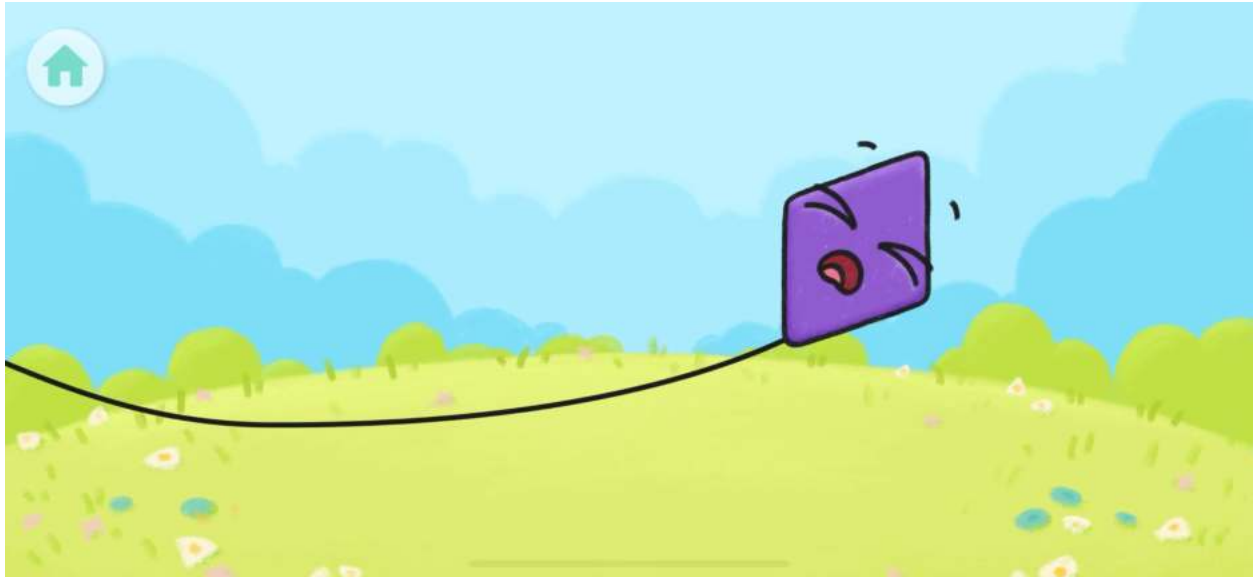


3. Unique Shapes theme video

After the child completes the lesson, they are presented with a unique shapes theme video, where they are taught about shapes and their unique “abilities and characteristics” (diamond is a kite and can fly, a circle bounces, a square has trouble moving, a triangle can’t even roll, etc.). The shapes are all around us (stars in the sky, the moon as a circle, etc.), and they learn all about them. Videos:

<https://drive.google.com/drive/folders/1EQu3ltyEsIOzmUyDX-osFALYmhGwt3mk?usp=sharing>





ABC Game





The central premise of the ABC Game is for children to have fun while mastering their ABCs. The game helps the child connect the sound and shape of each letter to a word it represents. These are the early foundations they will need to develop reading and writing skills.

It is a simple alphabet game where the child needs to jump over the letters, draw the letters and then complete a puzzle to arrive at the final part - playing with the object he created in the puzzle game.

The game includes a variety of objects, with more to come. The objects include

- A: Apple
- B: Book
- C: Cookie
- D: Doughnut
- E: Egg
- F: Flower
- G: Ghost
- H: House
- I: Igloo
- J: Jam
- K: Ketchup
- L: Leaf
- M: Mushroom
- N: Ninja

- O: Orange
- P: Pie
- Q: Queen
- R: Rainbow
- S: Spider
- T: Tomato
- U: Umbrella
- V: Volcano
- W: Watermelon
- X: Xylophone
- Y: Yoyo
- Z: Zeppelin

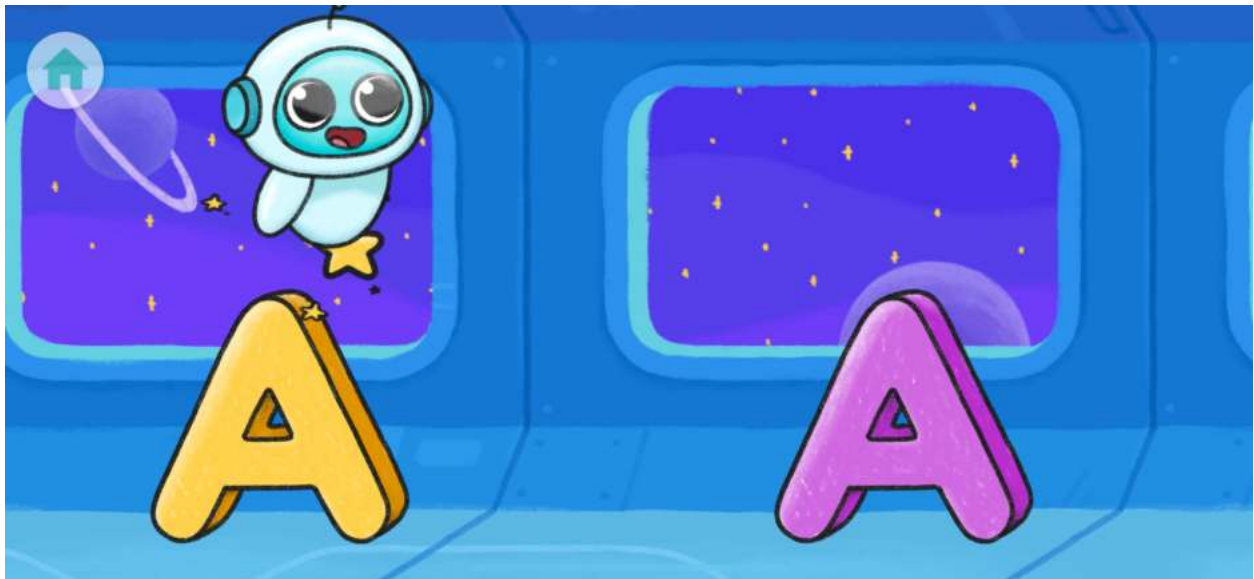


The mechanics are threefold:

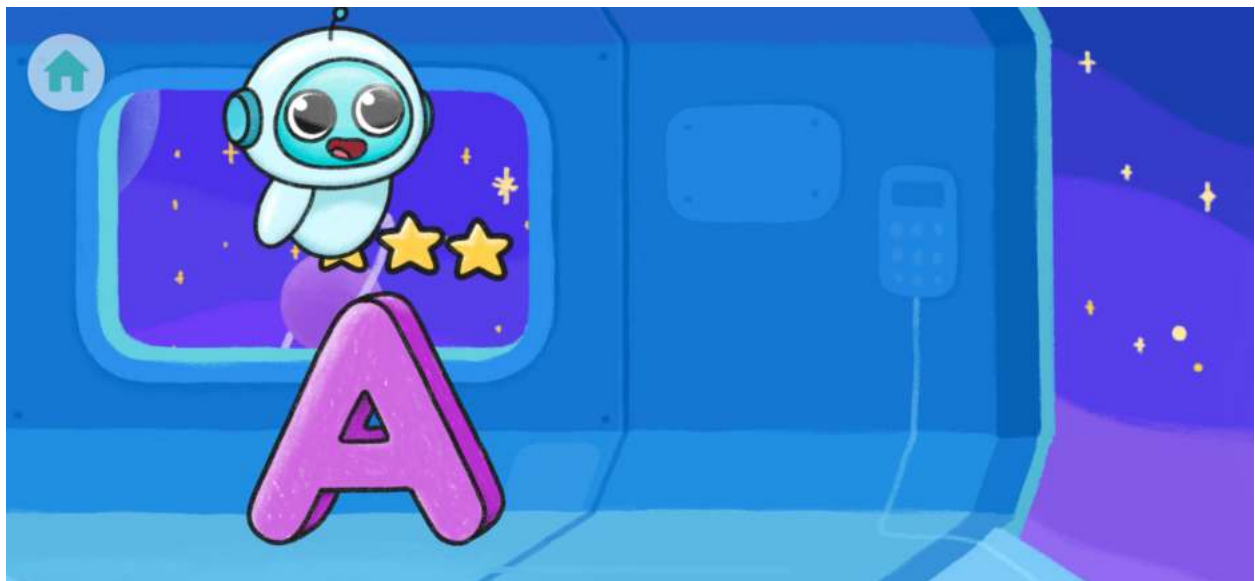
1. Jumping over the letters
2. Tracing the letters
3. Puzzle

1. Jumping over the letters

The first stage utilizes a simple mechanic of a robot jumping over the selected letter; to jump, a child needs to tap or hold on time. Above each letter is a varied number of stars that the robot collects upon passing through them. At each jump, the child hears the selected letter pronounced. Upon reaching the sixth letter in the sequence, the game proceeds to the letter tracing stage.

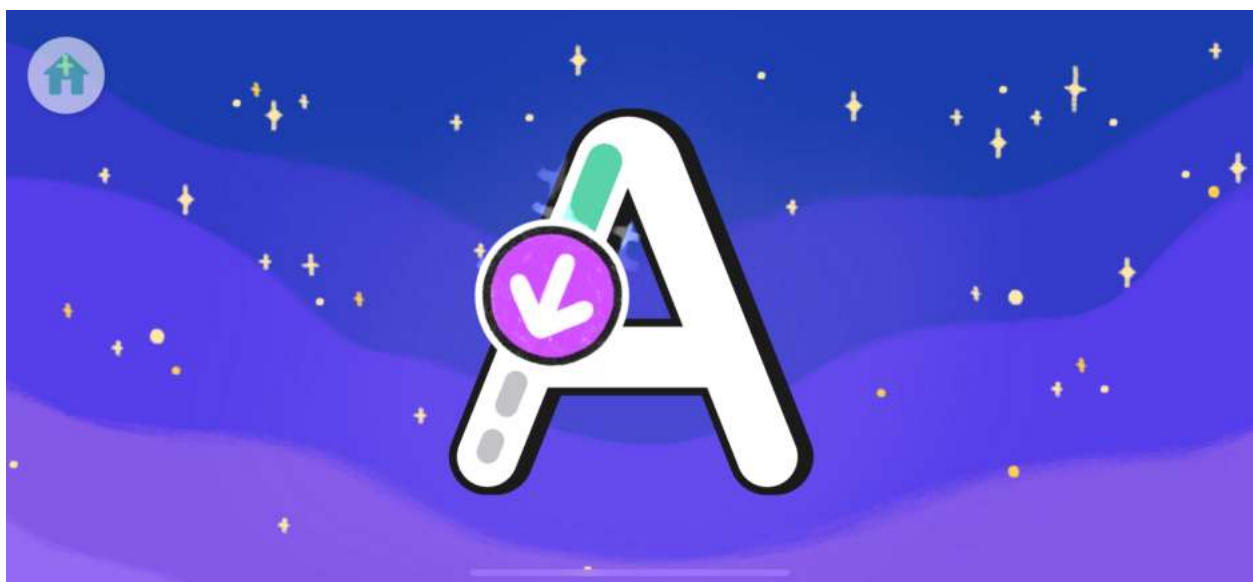






2. Tracing the letters

In the second stage, the child is required to trace the chosen letter. They follow a step-by-step tracing prompt to form the shape of the letter as they would write it later in life. This exercise not only teaches pre-writing skills, but also refines digital motor skills and precision.







3. Puzzle game

In the final stage, an object is connected to the letter in the first two stages. The object is broken into two pieces and creates a simple puzzle. The child is now expected to press and drag each of the pieces of the puzzle in the center and create a complete puzzle. The word is spelled out loud when the puzzle is completed.







After the child completes the lesson, they can press on the object to make it jump, shake and change faces.



Routines Game





Introducing routines, especially things like brushing teeth, is an integral part of growing up. This game aims to replicate real-life routines into an educational game. It teaches children about daily routines, especially hygienic routines. The child can wash a dog or a cat, with one lesson set in the morning and another in the afternoon. The game consists of three steps, at the end of which, the child is rewarded with a video about the previously-explored routine.

The three hygienic routines are as follows:

1. Cleaning the hands
2. Cleaning the face
3. Brushing the teeth

1. Cleaning the hands

In the first part, the child is given soap to lather the animal's paws. Afterward, they must wash the soap away with water, and in the final part, they dry the paws with a towel. All this is done by dragging/scratching and tapping the screen area.







2. Cleaning the face

The same procedure is used for washing the face.

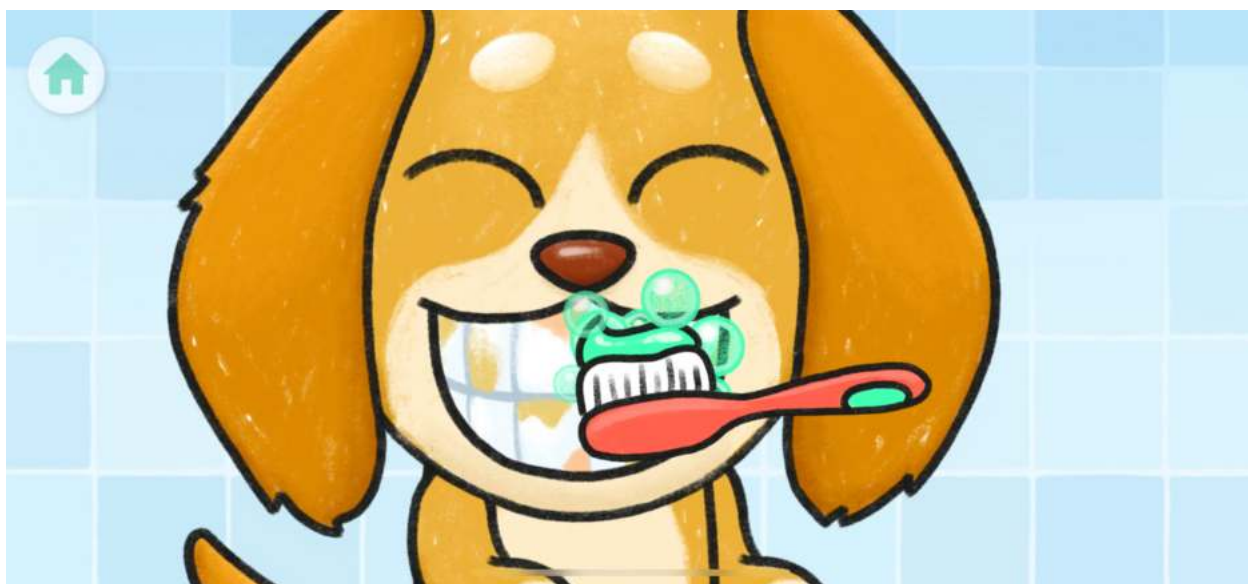


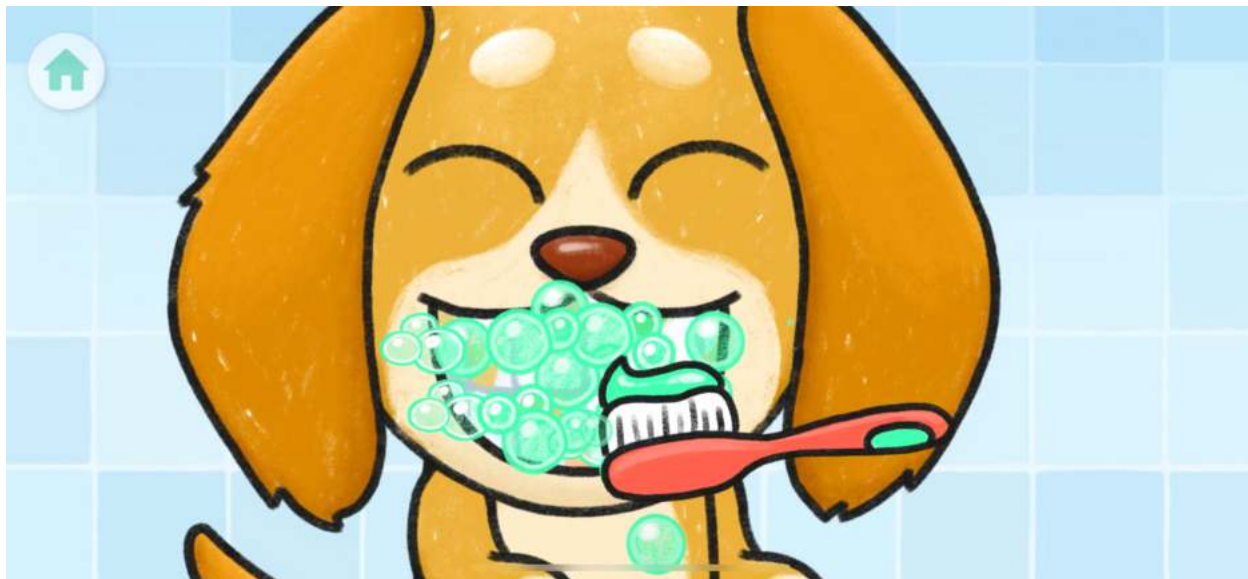




3. Brushing teeth

In the final stage, our pet needs their teeth cleaned. The child is given a toothbrush with toothpaste, and they must drag/scratch the pet's teeth.



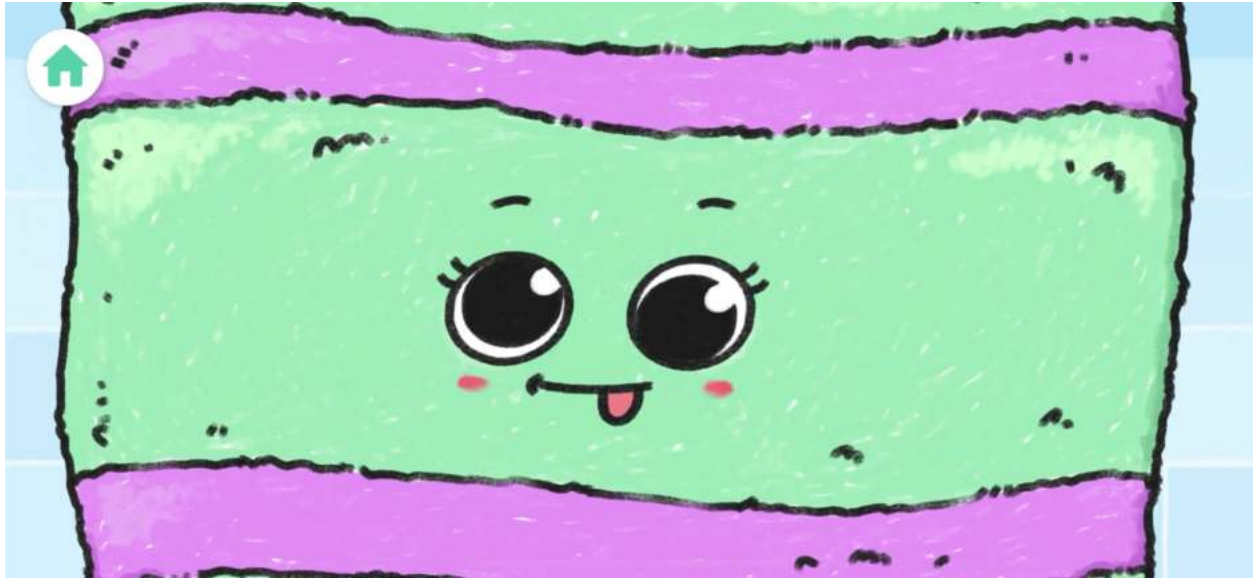




After the child completes the lesson, they are presented with a fun and educational nursery rhyme of the routine.



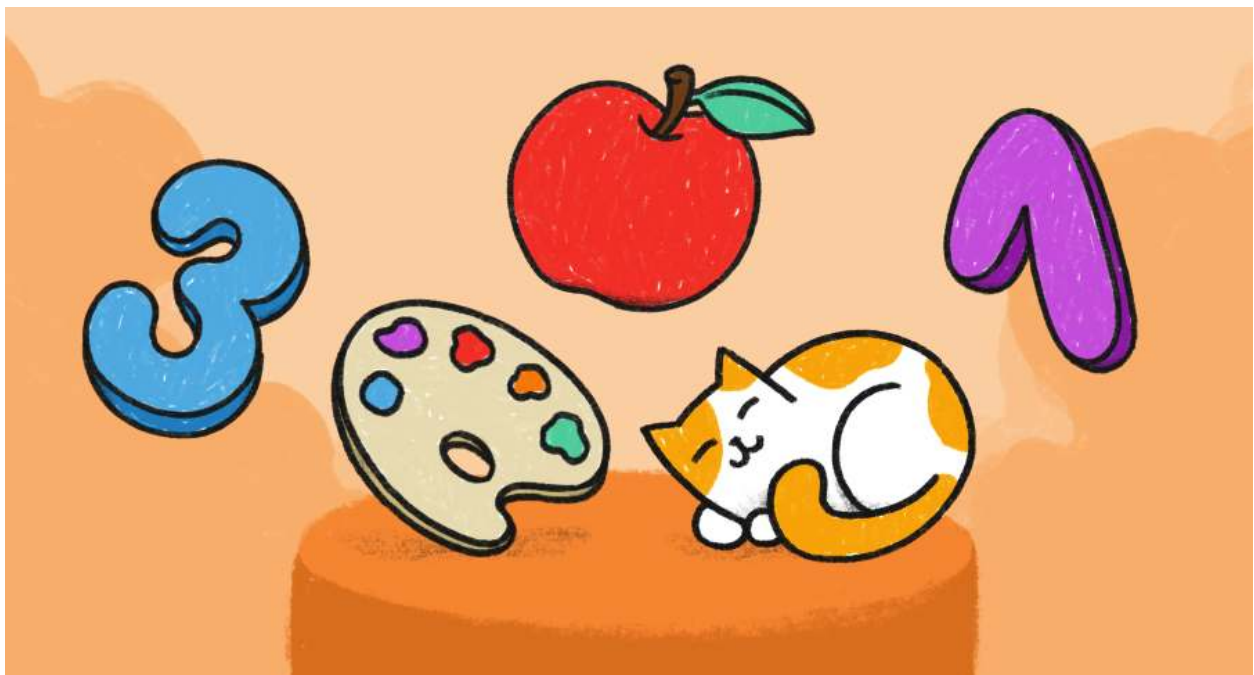




Matchy Match Game



One of the all-time favorites, the Matchy Match Game aims to help a child make sense of their expanding world by teaching them to connect objects and concepts. The child will learn what objects do, where they belong, and how they work together.



1. The child is shown a present from Finny. They get to open one present for every 4 exercises that they complete.
2. In each exercise, one object is placed on the pedestal, and the child has to choose one of the three objects below the pedestal to match the main object. The sets of exercises get progressively harder:

a) In the first set, the child has to match (for example) a yellow rubber duck to the same-looking yellow rubber duck. The remaining two objects they can choose from (the incorrect objects) are different and of different colors (e.g. a blue book, a cow, or a school bus).

b) In the following sets, it gets harder, e.g. the child has to match the right color object to the main object. E.g. they are shown a blue hat and have to choose between a blue, red, or green hat. The correct answer is the blue one.

c) In the more difficult stages, they have to choose an object that performs the desired action out of a choice of three different objects. For example, a muddy pig needs to be soaped up with a bar of soap (not with a banana). The exercises within this stage are interconnected and follow a logical sequence. E.g., the first exercise in the set is to soap the muddy piggy, the second exercise in the set asks to choose the right object to wash with the soap, and in the third exercise, the child needs to choose an object to dry the now wet piggy.

3. When the child presses the correct object, he gets praised, and the incorrect objects disappear. When they press on an incorrect object, the object doesn't disappear, it shakes, and the wrong guess is accompanied by a discouraging sound.

4. After every individual correct choice (the exercise is completed), Finny appears on a progress bar and moves left on the progress bar, closer to the wrapped present promised at the beginning.

5. After four exercises are completed, Finny reaches the present. He unwraps it and the object inside is revealed (e.g., a book, a hen...).

Learning within Matchy Match:

1. Similarities and differences between objects

a) Two things can be the same or they can be different

b) Two things can be the same in shape and form but of different colors

2. The correct sequence of actions

a) E.g. the muddy piggy needs to be first soaped, then washed, and lastly dried

3. Quantities

a) Matching three bananas (not one) to the number 3, or two ducks (not three) to the number 2

Benefits for toddlers:

- Training visual memory when identifying similarities and differences
- Learning about representation and relationships between objects
- Boosting problem-solving skills when identifying the correct sequence of actions
- Nurturing patience: the child needs to complete four exercises to receive a present
- Expanding vocabulary
- Practicing concepts from other Speech Blubs activities, such as colors and numbers, in context

PART 2: Behind the Games

Proof of Concept

The Speech Blubs app is designed for young children, specifically those aged 2 or under, who may be struggling with expressive language skills. The app includes games that are meant to provide mental breaks and engage children while also helping them develop their language skills. The games expose children to new vocabulary and provide contextualized and focused exposure to new words, which can lead to vocabulary expansion and improve their ability to learn new words. The games also promote digital literacy skills and fine motor skills and encourage ludic learning and learning through song. The app is designed to meet the needs of young children who are strengthening their language and motor skills and may have stronger receptive language skills than expressive skills. The app aims to provide exciting and engaging learning opportunities that give children confidence and encourage them to try talking.

Who is the app for?

Internally, Speech Blubs noticed that the majority of their users were 2 or under, and started to ask themselves if they were serving their users' diverse needs as well as possible. Yes, the app is full of language-boosting games, but extensive speech therapist review revealed that some professionals found that the game could use more games. They supported their claim in two ways: the first, was that children could benefit from more mental breaks; working on speech is difficult, especially for children whose speech doesn't come easily, so they need more gamified elements to simultaneously prime themselves for ludic learning, and mitigate the stress and exertion of working on their language development. Secondly, the therapists raised the salient point that many 1-2 year olds are not yet fully verbal, and that they could benefit from another form of engaging language, particularly one that was even more fun.

Indeed, the Center for Disease Control confirms their findings that Speech Blubs's youngest users could benefit from less expressive-language-demanding exercises. They find that at two years of age, children are typically stronger in their receptive language skills than their expressive skills (CDC, 2022).

At this age, children are strengthening their language and motor skills. They learn by copying, listening, watching, and trying again. They can understand more than they can express (which often ends up being cause for frustration), and so need learning opportunities that excite and engage them, while giving them the confidence to take a stab at talking. To meet these needs, learning opportunities should be exciting, and give them more than they expect in return (sources: CDC, 2022; Alli, 2021; Gavin, 2022).

What do games do for them?

Exposure to words

The games' most significant benefit for children is conscious and careful exposure to new words. Indeed, vocabulary expansion can be optimized by how words are presented to children.

"Input plays an important role in these differences. The quantity of language input directed toward children significantly affects children's vocabulary size, how they process language, and their subsequent academic success (Hart, 1995). Similarly, differences in the quality of language input (e.g., whether children hear words presented in isolation; (Brent, 2001)), whether the speech they hear is directed toward them (Schreiner, 2017), the mean length of the utterance they hear (McRoberts et al. 2009), and the kinds of questions directed at them (Cristofaro and Tamis-LeMonda, 2012) shape how children process language and their later vocabulary" (Ackermann, 2018).

This study finds that children learn words most optimally when they are exposed to fewer words with more repetition, however, the words should be presented in context rather than in isolation. Furthermore, words should be directed at the child, rather than displayed passively. The Speech Blubs Educational Games take all of these principles into account to deliver experiences that give children repeated, contextualized, and highly focused exposure to new vocabulary. The games provide a more immersive environment that allows the new words to shine, and promotes deeper absorption. One of the myriad benefits of vocabulary expansion is that it is a gift that keeps on giving. As their vocabulary grows, children are able to add new words faster, put another way "children can build on their lexical knowledge to learn new words" (Ackermann, 2018). Once children start to recognize and understand more and more words, it becomes easier for them to splice sentences into words, and identify parts they do and do not recognize. It is then easier to assign meaning to a new spliced out sound group, which is what learning a word is. Ackermann gives a salient example: "For instance, when 4½-month-olds hear sentences like Mommy's cup was *bright and shiny*, they can extract words from the speech stream more easily when the word cup is preceded immediately by a familiar word (e.g., Mommy; Bortfeld, 2005)." (Ackermann, 2018) Familiarity with neighboring words helps children identify and learn new words, as well as hone their sound-distinguishing skills so they can differentiate similar-sounding words, and identify frequently co-occurring words. Furthermore, when children learn words by solving for a gap in a sentence, they interpret the experience as a game they participate

in. It appears to be more interesting than being told what a word means, since the child gets to come to a learning on their own. Miller and Gildea confirm that when children “are given a sentence that is relevant to the story and uses the word in the same context, they interpret it as a puzzle to be solved. They spend more time thinking about the meaning of the word and remember it better a week later” (Miller and Gildea, 1987).

It is because of findings such as these that the games section of the Speech Blubs app differs in design from older content. The games are made for the younger children who come for speech support, which at their age looks like vocabulary expansion work. Later parts of the app instead seek to target older children and different skill sets. More information on other parts of the app are beyond the scope of this paper, but can be found at speechblubs.com/research.

Another way that vocabulary expansion is cumulative is through phonetic similarities. Research suggests that “every word a child knows could help learn new words, leading to a potentially cascading explosion of words once the child has learned a few initial words. If this is the case, words may cluster in the early lexicon according to their phonological characteristics (Mani and Plunkett, 2011), and words acquired early may have more phonological neighbors than words acquired later (Storkel, 2004). Research supports both suggestions” (Ackermann, 2018). What this means is that children are likely to add words with phonological similarity to their vocabularies. Recall early childhood exercises such as rhyming words like bat, cat, and hat. This concept explains the value of these exercises, as children are more likely to retain and recognize words with sounds they already know. A similar “association effect” is observed when words are connected to their referents. More explicitly, children are more likely to learn the word for something that looks like a thing they already know, than something dissimilar. For example, if the child can recognize and name a cabbage, they are more likely to learn the word for lettuce than the word for carrot. Ackermann confirms that “results are similar for the connectivity of words in the early lexicon based on the shape or color of objects referred to by particular words (Bobb and Mani, 2016), (Mani et al, 2013)” (Ackermann, 2018) These findings suggest that a child’s existing vocabulary can predict which words they are likely to acquire next.

Positive language learning association

Another principle that underlies the Speech Blubs Educational Games is interest-driven learning. The research is clear that children learn better when the learning is self-directed, and based in games and puzzles that are thematically interesting to them. The findings say that “curiosity-driven approaches place infants in a more active role, with learning guided generally by children’s intrinsic motivation to learn and specifically by a desire to reduce uncertainty in knowledge (Oudeyer and Smith, 2016)” (Ackermann, 2018). Essentially, when children are interested, they are engaged, and learn more. It is for this reason that Speech Blubs Educational Games are made to be enjoyed, and intellectually interesting for younger kids – enjoyment promotes curiosity, retained attention, and stronger,

more effective learning. Naturally, children have a wide range of interests, shaped by their varied personalities and experiences. Therefore, in order to interest and help as many children as possible, Speech Blubs Educational Games try to encompass as great a breadth of content as possible, ranging from the most universal shapes, food, and routines, to more varied items in games such as matchy-match. In fact, children's interest is "tied intrinsically to their current state of knowledge (i.e., what they know and do not know), and both factors interact to affect success in learning" (Ackermann, 2018). This assertion means that children are both interested in what they recognize, and what they do not; one would be remiss to only focus on one group. It is important then to strike a balance between the familiar and the unfamiliar in order to be intriguing.

Furthermore, "children are interested in learning new words that are sufficiently similar yet different from what they already know (e.g., novel members of well-known categories; Borovsky et al, 2016)." (Ackermann, 2018). The understandings gleaned from the above research teach that game content should be thematically familiar, or recognizable for the audience, while presenting a certain aspect of the unknown so as to retain intrigue. In short, a game should be a solvable puzzle for the child. This theory is baked into the core of the Speech Blubs Educational Games. The content is made to be familiar, and also moderately challenging, encouraging reinforcement and novel learning alike. Furthermore, mechanics allow children to solve new puzzles, giving them new and intriguing ways to apply and understand the words they learn. Another benefit of the Speech Blubs Educational Games is the autonomy they give children. Research finds that "children choose not only what they would like to learn but from whom they would like to learn and when they would like to be given more information about their environment" (Ackermann, 2018). The games allow children to follow their interests, and choose exactly what they would like to explore and learn from. In this way, they are able to learn at any moment, and are not limited by availability. In this sense, they are able to be guided by their curiosity, and grow their vocabulary intuitively. Children are encouraged to follow what is naturally interesting to them instead of a prescribed program, and the research shows that they will be intuitively interested in topics and words that mimic what they already understand (even if they do not express the words yet). It is by this method that children can enjoy rapid and efficient vocabulary growth.

Digital Literacy Skills

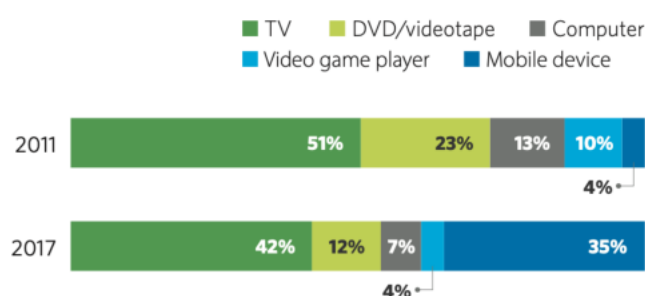
The games also help children develop a skill no previous generation has needed as much: digital literacy. Common Sense Media, the United States' "leading nonprofit organization dedicated to improving the lives of all kids and families by providing the trustworthy information, education, and independent voice they need to thrive in the 21st century" is at the forefront of safely guiding children through childhood, especially in the digital landscape. When asked about technology, the organization has the following advice: "Tablets are valuable learning tools for children that provide access to a multitude of

educational games, activities and more. With a tablet, children can explore the solar system, hone their math skills or read about ancient history right from the palm of their hand. Learning to use a tablet also prepares children to use this technology in school and eventually in the workplace” (Common Sense Media, 2017). There is no doubt that children will need digital literacy skills as soon as they touch their first piece of technology, and likely for the rest of their lives. Of course, children should not spend all their time on screens, but knowing how to use them is nonetheless an essential skill to cultivate. KidsHealth reports that “time [up to one hour a day for preschoolers] spent with devices (like a TV, tablet, or smartphone) can help reinforce learning and promote creative play when you choose educational programs, games, and apps. But too much screen time may lead to learning and sleep problems and increase a child’s chances of obesity.” (Ben-Joseph, 2022), confirming that while there is value in screen time, it is essential to do it intentionally, with well-crafted content such as Speech Blubs Educational Games. Professionals recommend that preschoolers can watch up to 1 hour a day of high-quality educational programming. In fact, KidsHealth suggests parents use different resources to vet the quality of content for their children, including Common Sense Media, [who gave Speech Blubs a perfect quality rating](#) (Ben-Joseph, 2022).

Common Sense Media conducted a review of screen usage in children, with a microscope put on children two and under. It confirms that overall, screen usage is on the rise. In 2011, less than 1% of children age 8 or younger had their own tablet device. In 2017, this percentage rose to 42% of young children having their own tablet.” (Common Sense Media, 2017), however the content of the screentime has shifted.

FIGURE B. Screen Media Use, by Platform, 2011 vs. 2017

Among 0- to 8-year-olds, share of time spent using:



Note: Video game player includes console and handheld players. Mobile device includes smartphone, tablet, iPod Touch, or similar device. Totals may not add to 100% due to rounding.

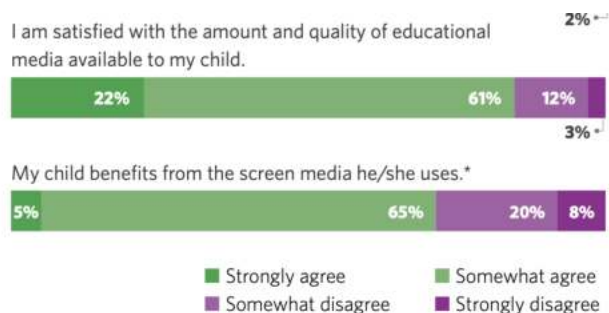
(Common Sense Media, 2017). Later in the 2010s, the share of time children spend on TV decreased by almost a fifth, whereas time spent on a mobile device increased almost ninefold.

Zooming into the population two and under, Common Sense Media reports that 46%

of children under 2 have used mobile media, only 9% of children under 2 use mobile media every day, and the average time spent on a mobile device among this age group is only seven minutes a day. Screen time with the littlest users is definitely limited, as is recommended by professionals around the world, from the CDC to Speech Blubs (Common Sense Media, 2017).

With such concentrated usage, it is important to pack as much value as possible into a couple of minutes, while prioritizing both child and parent satisfaction. A Canadian study finds that “children as young as 2-years of age were enthusiastic and attentive to an interactive touchscreen device and could learn to operate it purposefully to achieve a goal or to enhance a story” (Courage et al, 2021). The researchers looked at digital literacy skills across age groups, finding that the stronger a child’s executive functioning skills, the better their digital fluency. The researchers claim that these findings “add to a growing literature on the cognitive contents and skills (e.g., visuospatial, narrative, navigational) that toddlers can acquire from commercially available apps such as those they might have access to at home” (Courage et al, 2021), confirming that apps, like the Speech Blubs Educational Games, are successful in teaching children digital skills that are essential to learning from screens, and understanding how to manipulate a technology that will almost inevitably be a part of their future. Indeed, educational applications are a trend that does not appear to be in decline, it is even suggested that “the choice and availability of apps for toddlers that have educational content based on the science of learning (Hirsh-Pasek et al., 2015; Dore et al., 2019) will only increase” (Courage et al, 2021). There is no doubt that screens will be present in children’s lives, even starting at age two. It is however crucial to contextualize that there is little chance that screens will replace traditional ways to teach and play with children. Researchers hypothesize that “although apps will unlikely replace traditional shape skill toys or paper storybooks any time soon, the evidence to date suggests that they might prove to be a valuable addition to the toolbox of activities including, children’s spatial understanding and story comprehension more broadly. As such, they will continue to provide an alternative way to motivate, entertain, and instruct young children that will complement the traditional formats and could have implications for app design and policy development” (Courage et al, 2021). This added resource, or tool to empower and enable children to learn in ways they could not before, is precisely how Speech Blubs Educational Games is designed to function.

This direction, educational addendum and learning tool, is confirmed by how parents of children two and under see their current technology use.

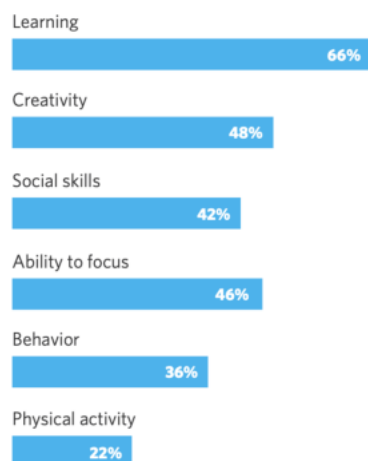


* Among those whose child uses screen media.

Note: Segments may not add to 100% due to rounding and those who didn't answer the question.

PARENTS' VIEWS OF MEDIA EFFECTS, BY CHILD'S AGE, 2017

Among those whose children use screen media, percent of parents who say media use helps the child's:



Note: Includes those who say media helps "a lot" or "a little."

(Common Sense Media, 2017)

These two graphics from Common Sense Media illustrate how parents of children aged two and under view their child's screen time. We can see that the vast majority of parents are able to find sufficient educational content in general, and that the children are able to benefit from that screen time. Paired with the top benefit parents find media to give their children (education) it is undeniable that parents recognize and use digital tools and digital literacy as necessary, and successful, for their children.

Cause-and-effect relationships

Another way Speech Blubs Educational Games help children learn is through strengthening their understanding of cause-and-effect. In order to understand the value of the games, it is important to first understand how babies and young toddlers understand cause and effect. This can be tackled in five parts: the basic premise of a child's

conceptualization of cause and effect, perception, perceptual matching over category, reasoning by analogy, and relational understanding.

In essence, the basic premise of children's understanding of cause and effect "derives more from a general ability to understand and explain the content of events than from a shift in assumptions about those cues which are fundamental to an identification of causal relations" (Bullock and Gelman, 1979). What this quote means is that children start learning cause and effect by identifying step-by-step stories. Indeed understanding the events going on is the very foundation of cause and effect.

One way that understanding these step-by-step stories happens is through seeing events transpire. For example, when a glass of milk is spilt, the table it is on gets wet, or when a button is tapped, a certain activity is triggered. What these examples have in common that differs from an adult understanding of cause-and-effect (say, that not paying off a credit card causes your credit score to lower) is spatial relations. Researchers confirm that "while order is a salient cue, it is not the only cue available to the child [...] the spatial relations between events are of concern to the child as well" (Bullock and Gelman, 1979). Indeed, for cause-and-effect understanding to develop, children need to be able to clearly and quickly connect the cause to the effect. Researchers confirm that "children find sequences which indicate the operation of action-at-a-distance to be surprising and in need of some explanation" (Bullock and Gelman, 1979), which can tell us that while these children are well on their way to understanding cause and effect, they need their initial introductions to be more immediately graspable.

This preference for visual proximity extends to how children prefer to match objects together. Studies (Christie & Gentner, 2010; Gentner & Namy, 1999) replicate that children have a strong preference for visually similar items instead of categorically-similar ones. In fact, "without scaffolding, preschoolers chose object matches over relational matches at a rate greater than nine times of ten", and "children favored even very far-flung perceptual matches to the categorical matches" (Goddu et al, 2020). Examples of such far-flung matches include "a target image of a bicycle with round wheels to an image of eyeglasses with round lenses, instead of to a scooter" (Gentner & Namy, 1999; Goddu et al, 2020). Many other studies also confirm that babies and young toddlers strongly prefer to match based on superficial similarities (e.g., Anggoro, Gentner, & Klibanoff, 2005; Baldwin, 1992; Gentner, Loewenstein, & Hung, 2007; Gentner, Simms, & Flusberg, 2009; Graham, Namy, Gentner, & Meagher, 2010; Imai, Gentner, & Uchida, 1994; Kotovsky & Gentner, 1996; Landau, Smith, & Jones, 1988, 1998; Loewenstein & Gentner, 2001; Namy & Gentner, 2002; Rattermann & Gentner, 1998a; Uttal, Gentner, Liu, & Lewis, 2008). This finding holds a couple of implications for Speech Blubs. The first helps explain the appeal of the "Matchy Match" game, whose mechanic, a classic memory game, leans into this inherent talent children have. The memory game is a treasured favorite among children, useful not only for its exposure to new words, but also for its identification and matching skills. The second implication shows up in prompting children to explore their vocabulary. In the Speech Blubs

App, children have the option to select “stickers”, which in the Games manifest as “tiles” that the child presses on to begin the game. This affinity for visual similarity relates to the aforementioned finding that a child’s current vocabulary is indicative of how their future vocabulary will expand – children seek words or referents they have some familiarity with. From a design standpoint, the Speech Blubs Educational Games maintain consistent graphics, sizes and color palettes to help ease the transition between new words and concepts.

The next step in understanding childhood cause-and-effect is grappling with the child’s understanding of reasoning by analogy. As has been established, devoid of other instructions, children favor pairings of images that share perceptual commonalities with a target concept. These visual similarities are more immediate than relational correlation between target concepts. However, that finding does not hold up when the children are given causal framing. When the two objects of choice are embedded within a cause-and-effect framework, the children perform an analogical transfer, and choose relational matches over visually similar ones. Summed up neatly, “findings suggest that causal framing facilitates early analogical reasoning” (Goddu et al, 2020). What this means for Speech Blubs Educational Games is that the games’ analogical connections help children advance their understanding of reasoning by analogy. For example, the jumping mechanics, the spinning shape-matcher, and the cooking aspect of the cuisine game teach children about transformation, and analogical cause through dissimilar-looking icons.

While children are better able to tease out relational association when given cause-and-effect cues, it turns out that those cues are best delivered linguistically. One source finds that “Many studies that demonstrate children’s consistent failure at spontaneous relational reasoning find, however, that explicit *sociolinguistic cues*—namely, *linguistic labeling* and *invitations to compare exemplars*—can improve children’s relational reasoning” (Goddu et al, 2020; Namy & Gentner, 2002). This information yields that prompting children, verbally, to compare, select, and evaluate relationships between referents in the best way to jog associative thinking and foster understanding of cause and effect. In the Speech Blubs Educational Games, every activity is verbally narrated, so a child’s learning is both scaffolded and supported. This verbal companionship not only enriches and supports their vocabulary, but also primes them for understanding cause-and-effect. In essence, the children who typically do not succeed in spontaneous analogical association are quick to detect cause-and-effect when told to look for it. Indeed, it is not that they cannot recognize it, rather it is not the most intuitive connection for them to make. Therefore, they need prompting and scaffolding to hone the skill, and strengthen the thought process. (Goddu et al, 2020)

Smart Screen Time

Studies show that children are not only more engaged, but can also gain more from smart screen time, or screen time that is carefully-curated, age appropriate, and beneficial to

engage in. Specifically, children should be engaged with in digital play the same way they would be engaged with in non-digital play. Video instruction can teach a breadth of skills either as an intervention on its own (MacDonald, Clark, Garrigan, & Vangala, 2005; Nikopoulos & Keenan, 2004b, 2007) or paired with prompting or reinforcement (Keen, Brannigan, & Cuskelly, 2007; Murzynski & Bourret, 2007; Reeve, Reeve, Townsend, & Poulson, 2007; Mehta, 2005). The benefit is not in the sheer presence of the screen, of course, but rather in how it is used. There is a real difference between using evidence-based video practices, and letting children watch any form of recorded video content, and that difference is smart screen time. It is at this point abundantly clear that children require active engagement in order to benefit from any activity, and that digital interventions can lend themselves especially well to that joy, activation, and interest, even more so than in traditional physical interventions. However, that intervention must be intentionally designed, such as with smart screen time. This observation was confirmed by Hoque (2009), who details how smart screen time can engender a heightened state of attention and absorption, which when combined with the sensory and perceptual needs of a particular client, can result in an excellent, active, and productive use of technology.

This is what Speech Blubs has sought to do. With thorough design ideation, extensive expert input, and constant reference to the literature around speech interventions and childhood technology usage, the app seeks to harness technology's potential and drastically minimize adverse effects. Furthermore, it recommends a 10-minute session a handful of times a week, not endless unsupervised play. The content, recommendations, layout, parent advice, and content are all based on scientific findings and methods proven to put children first and help them meet their goals.

Indeed, the Speech Blubs line of games are not made to be difficult to use. However, their ease-of-use cannot be confused with having low therapeutic value. Speech Blubs' games do not work like a school curriculum – children are not measured against objectives and graded, nor are they advanced on degree of completion of some exercise – the Speech Blubs line of games is made more to prime children for language-learning. The games aim is to give children feelings of success and positive accomplishment while giving them content they'll be able to internalize and understand, in order to later produce.

Studies show that warm and accepting interactions with children engendered reciprocity and engagement on the part of the child (Westerlund and Lagerberg, 2008; Safwat, 2014). At its simplest, positive reinforcement is just giving attention to desired behavior while attempting to ignore inappropriate behavior. Furthermore, the most effective positive reinforcers are those that are quick and easily attainable (Sigler, 2005). In the context of the Speech Blubs Educational Games, they do not attempt to punish or ignore inappropriate behavior, rather, they reward any interaction with the app (Sesame Street, 2012). This taps into the warmth and acceptance that encourages child participation, which then hopes to encourage sound and word production. The app is an environment where the

child cannot be scolded or criticized, but instead can be enriched and encouraged to start speaking.

Fine Motor Skills

Emphasis on digital literacy and hand skills for touch screens

It is well-recognized that around 2 years old, it is expected for children to be using tablets. At this age, they are old enough to benefit from the technology with low risk of hindering social abilities. In fact, the American Academy of Pediatrics recommends up to an hour a day of high-quality educational screen time. As increasing amounts of children have access to technology in school, their success becomes dependent on how adept they are at using it. It was found that upon learning how to use a digital tablet, toddlers' increased success and efficiency, made fewer errors, decreased completion times, and required less scaffolding across trials. In a storybook-reading app, they were also able to recognize more story content from the e-book and were less distracted than from the paper book ([source](#)). Learning how to use apps and screens is demonstrably connected to a child's academic success. Speech Blubs' games are made to introduce children to the fundamental mechanics and fine digital motor skills that will serve them throughout the rest of their lives. Establishing that toolbox now will give them the ability to move forwards in their educational journeys unhindered by not knowing how to navigate a digital tool. This holds true both for later Speech Blubs exercises, all the way to understanding how to use and manipulate college-level software.

Vocabulary Expansion

One crucial component of Speech Blubs' Games is how it helps children expand their vocabulary. A 2012 study by Meredith Rowe, cited by the Hanen Centre, confirms the importance of vocabulary. Indeed, vocabulary turns out to be an important indicator for overall school achievement, success in literacy, amount of information the child has access to, and potential to think about and interact with the world. Thankfully, helping children express their vocabularies is pretty approachable.

For children 12-24 months old, they benefited most from exposure to lots of words – the key was quantity. However, it will not suffice to just read a child a dictionary. Children need to have words repeated to them, while including meaning. This can be through visual cues (showing an image or an action), or storytelling, or both. Speech Blubs' games do just this. By repeating words multiple times and drawing a clear visual and narrative connection between the word and the referent, Speech Blubs' games support the vocabulary expansion of 12-24 month olds.

For toddlers aged 24-36 months, children expand their vocabularies by hearing more sophisticated words. For this reason, Speech Blubs' games include multi-step instructions, and exposure to new words via songs, nursery rhymes, and routines. Indeed, the app does not limit itself to words that children are able to express at that time, but pushes the

boundary to include novel and challenging words. (Lowry; Weitzman and Greenberg, 2010; Rowe, 2012; Hart and Risley, 1995). Naturally, the early childhood games tie into the rest of the Speech Blubs experience – vocabulary growth does not stop in any part of the app – however the degree of difficulty is scaled for different ages and abilities.

Over the course of speech therapist interviews, we were able to identify that there was a gap in speech-boosting apps: many of them were too noun-heavy. Speech Blubs' games intentionally work with more parts of speech, including verbs and adjectives, to help children have a more robust pool of words to pull from. This also helps them turn their repertoire of words into actionable sentences faster. Also baked into the utility of the games was relevant vocabulary. Speech Blubs' games explore topics that relate to every-day life such as food and hygienic routines. The section also includes shapes and letters, rounding out a set of fundamental conceptual topics that are less addressed in parts of the app that are designed for older users.

Ludic Learning

The efficacy of intrinsically-motivated pleasurable education can be explained by the concept of ludic learning. Ludic learning is quite simply a pedagogy that uses games to teach. The AAP confirms in a widely-cited study that “Play is not frivolous: it enhances brain structure and function and promotes executive function (ie, the process of learning, rather than the content), which allow us to pursue goals and ignore distractions” (Yogman, 2018). In fact, the app looks to break the false dichotomy between play and formal learning by showing how in fact, pedagogies that are enjoyable and entertaining can yield the best results. Active engagement and engrossment in an activity are purported to build “executive functioning skills and [contribute] to school readiness”. The literature is increasingly impassioned about the inextricable link between play and learning, citing heightened curiosity as the main catalyst for memory, learning, collaboration, and problem-solving skills that ludic learning frameworks spark in children. Indeed, these are skills and neural networks that children will not only need today and tomorrow, but in all likelihood skills that they will rely on and build upon for the rest of their lives (Yogman, 2018). However, not all games are built the same. An exhaustive literature review yields that there are a collection of key game elements essential to educational game design, such as narrative context, rules, goals, rewards, multisensory cues, and interactivity, seem necessary to stimulate desired learning outcomes (Dondlinger, 2007).

While Speech Blubs isn't a video game in the traditional sense, it can nonetheless use the learnings from educational video game design to assess how supportive it is of learning. The app is laden with reward. The children get ample positive reinforcement for working on their speech at all, and are praised for any progress or effort they can make. Speech Blubs will never penalize a child for not meeting milestones, not trying hard enough, or otherwise not meeting a performance indicator. Instead, there are different gradations of reward for the learning goal, and incorrect responses are treated as a step in the pedagogical process;

something that can be learned from. The app gives multisensory cues: visual, audio, and haptic to stimulate interest, entice engagement, and reaffirm feedback. A careful interaction of the three modes of stimuli seek to draw the user's attention to different elements of the app usage experience, from educational content connected to their real-world experiences, engagement prompts, and reward and reinforcement of the user's behaviors. Each exercise is densely packed with coded information and feedback that promotes prolonged interest and attention span in the educational content. Speech Blubs is deeply aligned with the ludic learning pedagogy; all of the design elements, from loading screens, to color palette, vibrations, and sound choices are made to encode therapeutic information and skills in a fun, gamified experience. A proverbial spoonful of sugar to help the medicine go down, the gamified Speech Blubs experience is designed to make educational benefits shine.

Learning Through Song

Singing is important for children's development in many ways. Exposure to song and instruments shows children cause-and-effect logic, reasoning, patterns, numbers, changes in pitch and sound, and new words. The underlying goal that connects all of these benefits is pattern recognition (Dodge, 2009). Human beings are hardwired to recognize patterns and make deductions from them (Salimpoor, 2013), especially in song, as it is one of humanity's oldest ways to pass down generational knowledge (Masataka, 1999). It's no coincidence that "parent speak" or "motherese" is composed of all the basic building blocks of music (intervals, melody, simple songs and singing...) and is very consistent across cultures (Welch, 2001).

Something about singing really sticks with humans. Perhaps it's the physical, soothing response humans have to it. Dr. Sandra Trehub shows that singing calms babies for twice as long as talking, even when they don't understand the words (or recognize the voice singing them). The rhythms and melodies are soothing in ways that speech isn't (Trehub, 2015). In another study, Trehub also found that babies with high levels of cortisol (a hormone affiliated with stress and arousal) had those levels reduce when they listened to singing. Conversely, babies with lower cortisol levels had their cortisol levels increase when listening to singing. Because the babies in the study all appeared content during the experiment, Trehub concluded that singing has a modulating effect on cortisol, keeping it in just the right range for positive attention. This evidence suggests that singing is most useful for helping babies regulate emotion and focus attention (Suttie, 2016). Now that we have established how the medium primes children for positive emotions and attention-paying, what do children actually stand to learn from songs? Songs can improve language skills, helping children increase vocabulary, phonological awareness, and reinforcing known words. They also promote math and counting skills by introducing rhythm, count, and beats. Although speech and musical skills develop independently they can be used to strengthen each other; musical and linguistic skills have been shown to be linked in young preschoolers, regardless of their non-verbal abilities and verbal memory. The timing and melodic skills

they possess are associated with language development, and are not just by-products of other cognitive skills and processes. It is not surprising then, that the rhythmic aspect of musical ability predicts phonological awareness and the melodic aspect of musical ability predicts language grammar (Politimou, 2019). Indeed, the highly organized, rhythmic, and logical structure of music mimics the universal ideas that underlie human language, and primes babies to understand what exactly is coming out of their parents' mouths, and how to dissect it. The same study responsible for the aforementioned finding also reveals that informal music exposure at home can positively impact a 3-4 year old's complex language skills. This is not to say that parents who don't play music for their children have locked them into a life of failure and parents who do are raising future CEOs, neurosurgeons, and world leaders — the Mozart effect has been thoroughly disproven. This finding just suggests that increased exposure to music and musical experiences helps to familiarize oneself with language, help with sound production and fluency, and strengthen connections between musical and linguistic skills at a crucial developmental stage (Politimou, 2019). Research yields that successful kids' songs will have repetition, games, and funny sounds and lyrics. These elements draw children in to catch their attention, and then promote language development skills, gross and fine motor skills, and most importantly, fun. There are five pillars to attractive music — catchiness, adaptability, repetition, relatability and transgression — and they're the same for humans of all ages (Underwood, 2020). Combining pleasure with pedagogy is the key to tapping into children's millennia of hardwiring (Dodge, 2009; Underwood, 2020).

The key to teaching through song is repetition (Dodge, 2009). In a private meeting in 2021, Sandra Trehub described how children that are not yet speaking may not understand that lyrics are composed of meaningful units — words — instead, they intake it as highly pleasant repetitive music. From listening, they're getting melody, intonation, rhythm, and words, not grammar and the nitty-gritty of language. That's what makes the medium so accessible to a wide array of children. Indeed, some of the first signing kids do is completing the last word of a line being sung to them. For kids to derive some meaning from the lyrics, they need to be very explicitly shown what word maps on to what real-life counterpart. The song itself needs to meet certain criteria for it to impact a child. First, the song must be highly familiar to the child — they connect with the song more than the singer or the instrumentals, so no matter how it's presented, children will love hearing a voice singing a pattern they know. Kids really respond to the predictability and familiarity of a song they know, so when they correctly guess what is coming next, it gives them a real sense of joy. Speech Blubs' nursery rhymes and routine-building games were designed with these principles in mind. The child-facing model is meant to encourage and leave space for children to participate, while the graphics allow children to understand context and connect new words with their meanings (not to mention reinforce words they already know). Furthermore, the children are clearly shown a chain of events in a logical, memorable sequence, helping them build routine awareness and memorization. The main characters

sing in happy, approachable voices that children can relate to and feel comforted by. The videos are short and rhythmic, provide opportunities for children to see themselves and sing along, repeat the song multiple times, and show visualizations in order to solidify understanding.

PART 3: Metrics

There are a lot of ways to measure success, but three of the metrics we use to determine that the Games section are performing how they were designed are: time spent in app, game popularity, and who is playing the games.

The average number of game sessions started per user in the first month of using Speech Blubs rose when Games were launched. Furthermore, upon Games' launch, the average total time spent on the app during the first month of usage increased as well. These two metrics confirm that the introduction of Games is correlated with increased time spent in the app. The conclusions that can be inferred from this finding are that the games help children spend more quality screen time on Speech Blubs, a research-backed speech therapy app. Indeed, the requests from various Speech Language Pathologists that we include more games to capture student's attention and keep them getting more therapeutic benefits for longer appear to be working.

Finally, game popularity is enriched by knowledge of who is playing the games. We can observe a spread of players, which describes what percent of all started exercises were games in the first month of Speech Blubs usage that shows us how popular Games are with each age bucket. The Games overall appear to be capturing attention, a finding confirmed additionally by the data on average session amounts and duration. We find the games to have the most popularity with the five and two year olds. We can speculate two reasons as to why. First and most simply, the two-year-olds are the demographic the game was designed for. They are the ones who use Speech Blubs as a primer to therapy, and the ones whose speech needs are made to be addressed within the games. The second hypothesis goes to explain heightened usage in five-year-olds. These children are likely using the games as a break between more intensive and demanding work on their speech. These children are likely captivated by different aspects of the Games than their two-year-old counterparts. These hypotheses give us insights into how the Games are being used, which allows us to tailor future work to making sure the results pout out align with overarching goals.

PART 4: The Future of Speech Blubs Educational Games

But this paper only outlines the beginning. As we speak, more and more content is being added to the games. The alphabet section now includes all 26 letters, as well as

seasonal activities for holidays. The games are not meant to be static. The content and themes will change and expand so that children will have something new to explore and look forward to as they come back to Speech Blubs.

Another part of the vision is to have the games increase in complexity. The version of a game enjoyed by a two year old will not give the same pedagogical value when that same child is four – so why not change the game. In the future, Speech Blubs Educational Games should grow with your child, leveling up as they progress through a game to keep them challenged and engaged until they are ready to move on to a different part of the app, or something else entirely.

The way the games work is also set for a change in the future. Keeping with the nature of Speech Blubs as a speech therapy app, the child's voice will become an increasingly important part of gameplay. While the demands won't be the same in the games as in say the classic video modeling exercises, more speech is expected to play a role in future gameplay.

If you are a Speech Therapist, researcher, dedicated Speech Blubs Research Reader, or other speech professional and you have ideas about how to make Speech Blubs Educational Games better, don't hesitate to reach out to us at hi@speechblubs.com !

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