

Learning Programming from Tutorials and Code Puzzles: Children's Perceptions of Value

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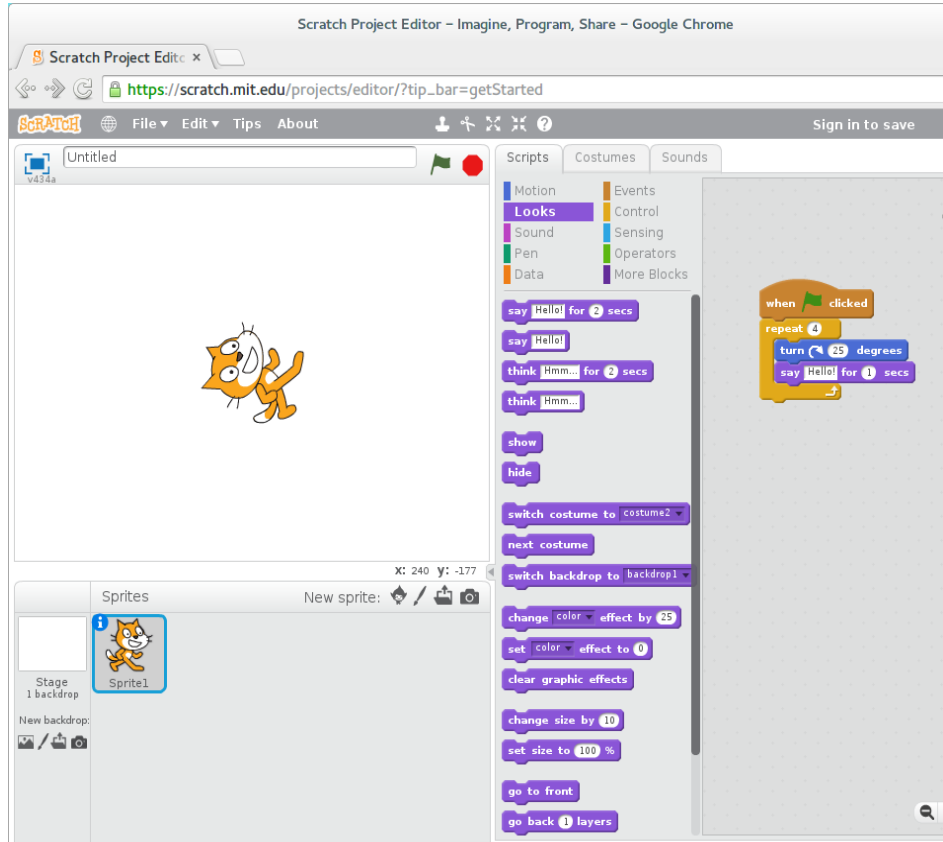
Meet Clara & Friend



Independent Learning Support in Novice Programming Environments



Independent Learning Support – Tutorials



Independent Learning Support – Code Puzzles

The screenshot shows the Code.org Minecraft Hour of Code interface. At the top, the browser address bar displays "Code.org - Minecraft Hour of Code" and the URL "https://studio.code.org/s/mc/stage/1/puzzle/1". Below the browser bar, a teal header contains the "C O D E STUDIO" logo, the text "Minecraft Hour of Code", a progress indicator with 10 circles (the first is filled), the text "I've finished my Hour of Code", and a "Sign in" button. The main interface is divided into three sections. On the left is a Minecraft game view showing a character on a grassy field with some trees and a red sheep in the distance. Below the game view is a blue "Reset" button. In the center is a "Blocks" panel with three code blocks: "move forward", "turn left", and "turn right". On the right is a "Workspace" panel showing a "when run" block with two "move forward" blocks stacked below it. At the bottom of the workspace are "Start Over" and "Show Code" buttons. A red box highlights a hint area at the bottom left of the workspace, which contains a character icon and the text "Add a second 'move forward' command to reach the sheep." A red arrow points from the number "5" in the bottom left corner of the slide to this hint box.

Code.org - Minecraft Hour of Code
https://studio.code.org/s/mc/stage/1/puzzle/1

Minecraft Hour of Code 1 I've finished my Hour of Code Sign in

MINECRAFT

Blocks Workspace: 3 / 3 blocks Start Over Show Code

move forward
turn left
turn right

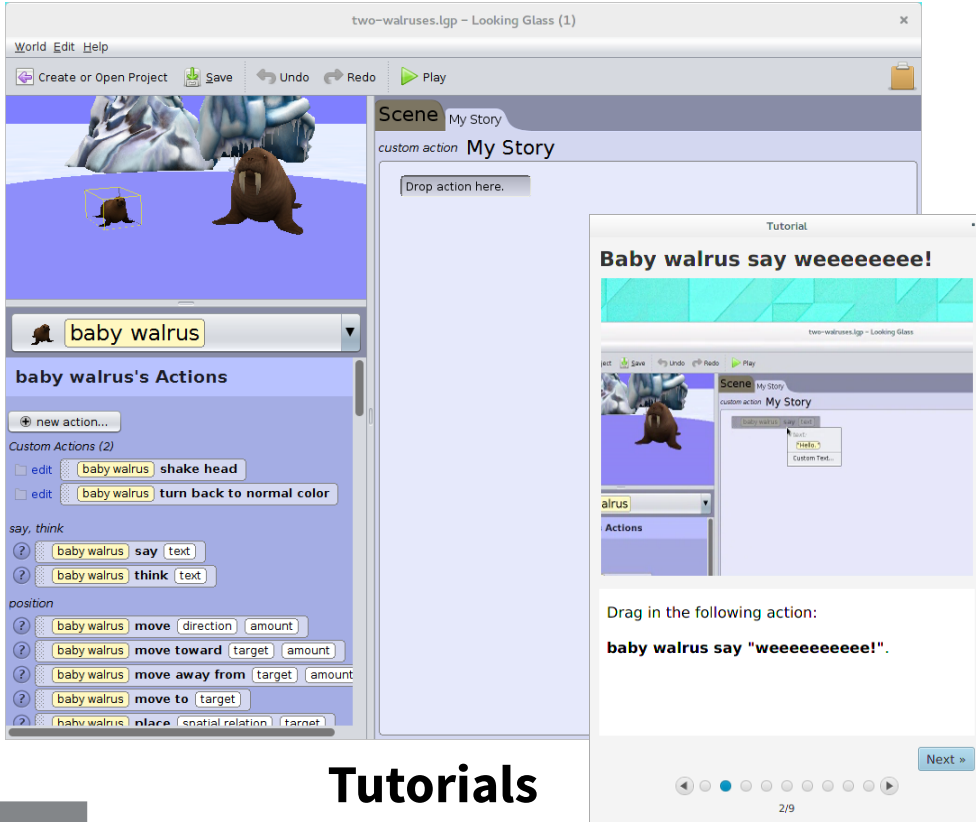
when run
move forward
move forward

Reset

Add a second "move forward" command to reach the sheep.

5

Independent Learning Support: Tutorials vs. Code Puzzles



The screenshot shows the 'two-walruses.lgp' environment with a 'Looking Glass (1)' window. The main scene displays two walrus characters on a blue surface. A 'Scene My Story' panel is visible, showing a 'Drop action here.' prompt. A 'Tutorial' window is overlaid, titled 'Baby walrus say weeeeeeeee!' and 'two-walruses.lgp - Looking Glass'. It contains a 'Drag in the following action:' prompt and a 'baby walrus say "weeeeeeeeeee!"' action block. The tutorial also shows a 'Next >' button and a progress indicator (2/9).

Tutorials



The screenshot shows the 'two-walruses.lgp' environment with a 'Looking Glass (0)' window. The main scene displays two walrus characters on a blue surface. A 'custom action My Story' panel is visible, showing a 'Drop action here.' prompt. A 'Code Puzzles' window is overlaid, titled 'two-walruses.lgp - Looking Glass'. It contains a 'Use all of these actions to put the animation back in the correct order.' prompt and a list of actions: 'baby walrus set color green', 'baby walrus say "uh oh"', 'baby walrus turn RIGHT 8.0 rotations duration', 'mommy walrus shake head', 'baby walrus turn back to normal color', 'baby walrus say "weeeeeeeeeee!!"', and 'mommy walrus turn to face baby walrus'. The puzzle also shows 'Play Correct' and 'Play Mine' buttons.

Code Puzzles

Tutorials vs. Code Puzzles: Motivation



Tutorials

Code Puzzles

Research Questions

What decisions do users make?

Are code puzzles more motivating than tutorials?

What are users perceptions of value for each instructional format?

Motivation?

Learning?



Exploratory Study

30 participants (10 to 15 years)

14 female, 16 male

Average age: 11.2 years

6 Instructional Tasks

For each pick an instructional format:

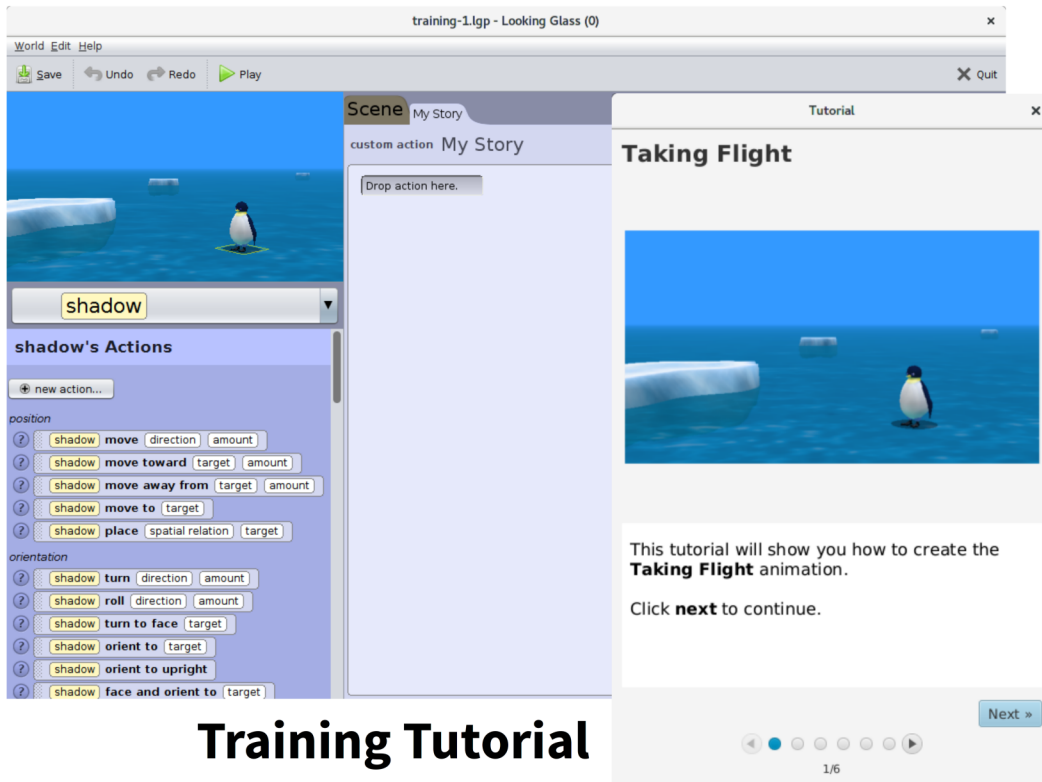
tutorial

code puzzle

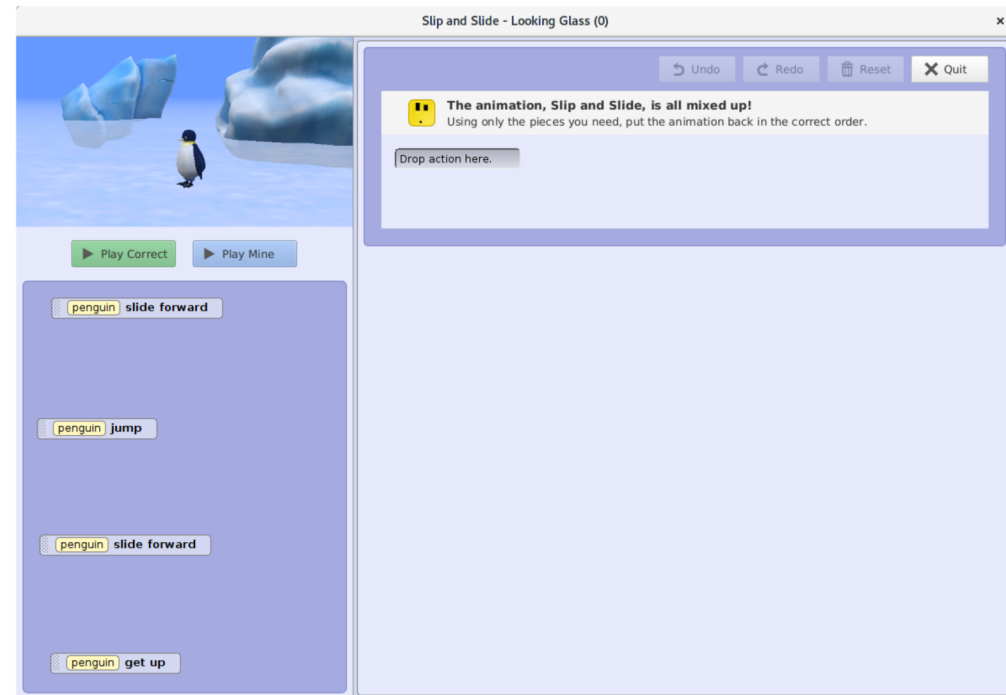


LookingGlass

Training

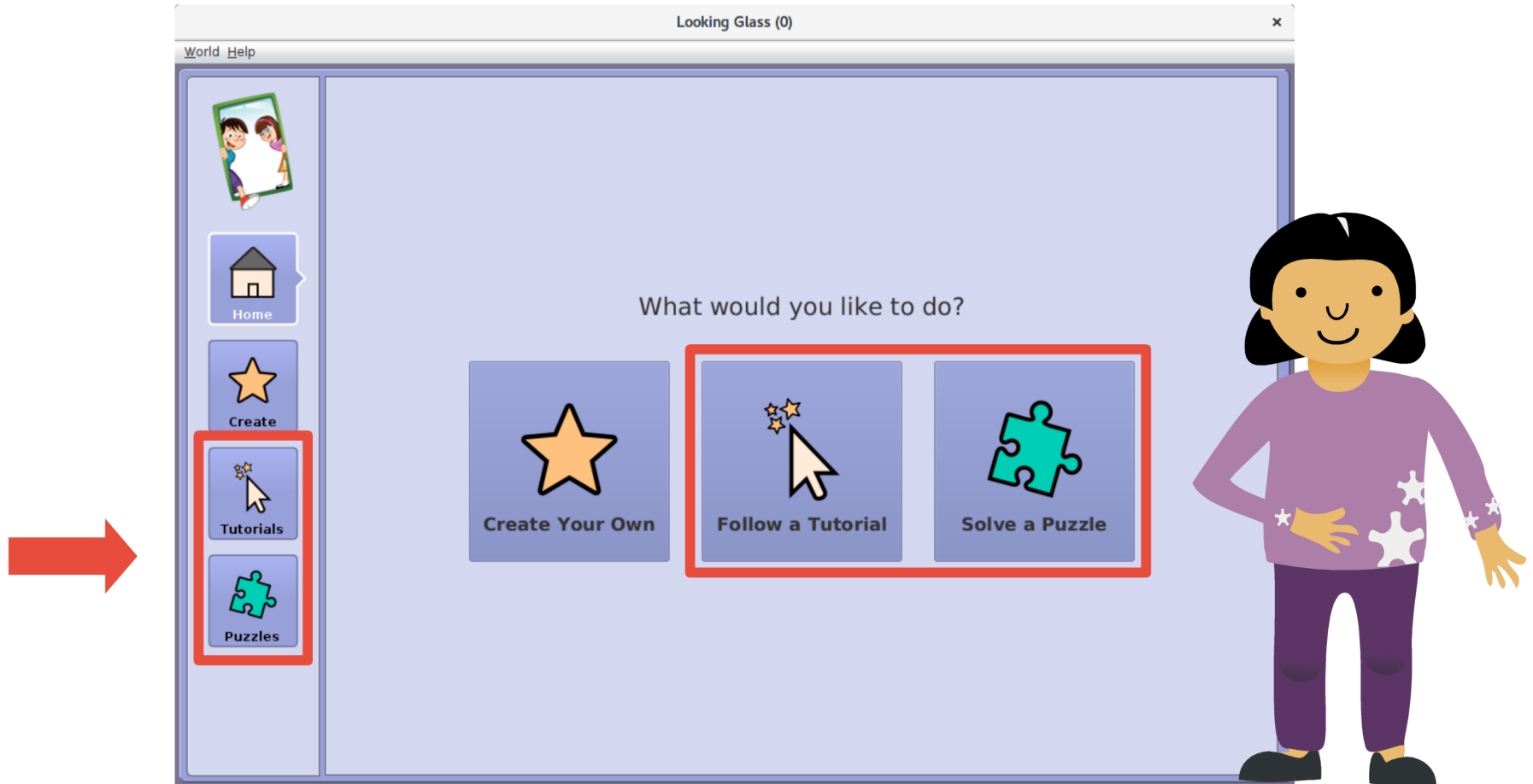


Training Tutorial

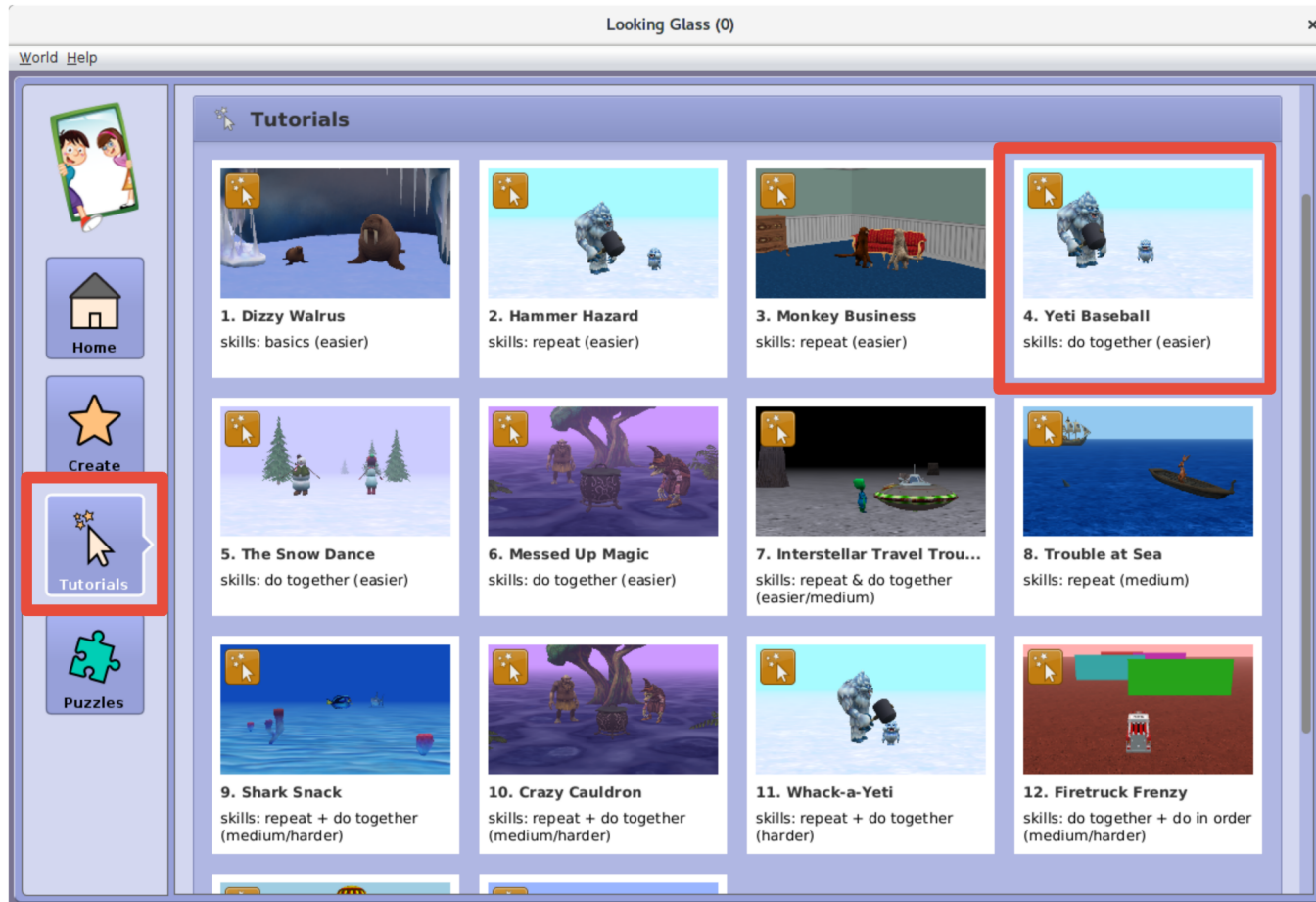


Training Puzzle

Choose Instructional Format: Tutorial or Puzzle



Instructional Tasks: Tutorials



Instructional Format: Tutorial

The image displays a programming environment with a main workspace and a detailed tutorial window. The main workspace shows a scene with a 'tiny yeti' object and a list of actions. A red arrow points to the 'turn to face' action in the 'orientation' category. The tutorial window, titled 'Tiny yeti turn to face big yeti', shows a list of actions for the 'tiny yeti' object, with the 'turn to face' action highlighted. A red arrow points to this action in the tutorial window. Below the tutorial window, a text box instructs the user to 'Drag in the following action: tiny yeti turn to face big yeti.' A red arrow points to this text box. The tutorial window also includes a 'Next' button and a progress indicator showing 2/12 steps.

04.lgp - Looking Glass (0)

World Edit Help

Save Undo Redo Play

Scene My Story

custom action My Story

Drop action here.

tiny yeti

tiny yeti place spatial relation target

orientation

tiny yeti turn direction amount

tiny yeti turn to face target

tiny yeti orient to target

tiny yeti orient to upright

tiny yeti face and orient to target

visibility

tiny yeti appear

tiny yeti disappear

size

tiny yeti resize factor

tiny yeti resize width factor

tiny yeti resize height factor

Tutorial

Tiny yeti turn to face big yeti

tiny yeti

position

tiny yeti move direction amount

tiny yeti move toward target amount

tiny yeti move away from target amount

tiny yeti move to target

tiny yeti place spatial relation target

orientation

tiny yeti turn direction amount

tiny yeti roll direction amount

tiny yeti turn to face target

tiny yeti orient to target

tiny yeti orient to upright

tiny yeti face and orient to target

visibility

tiny yeti appear

tiny yeti disappear

size

tiny yeti resize factor

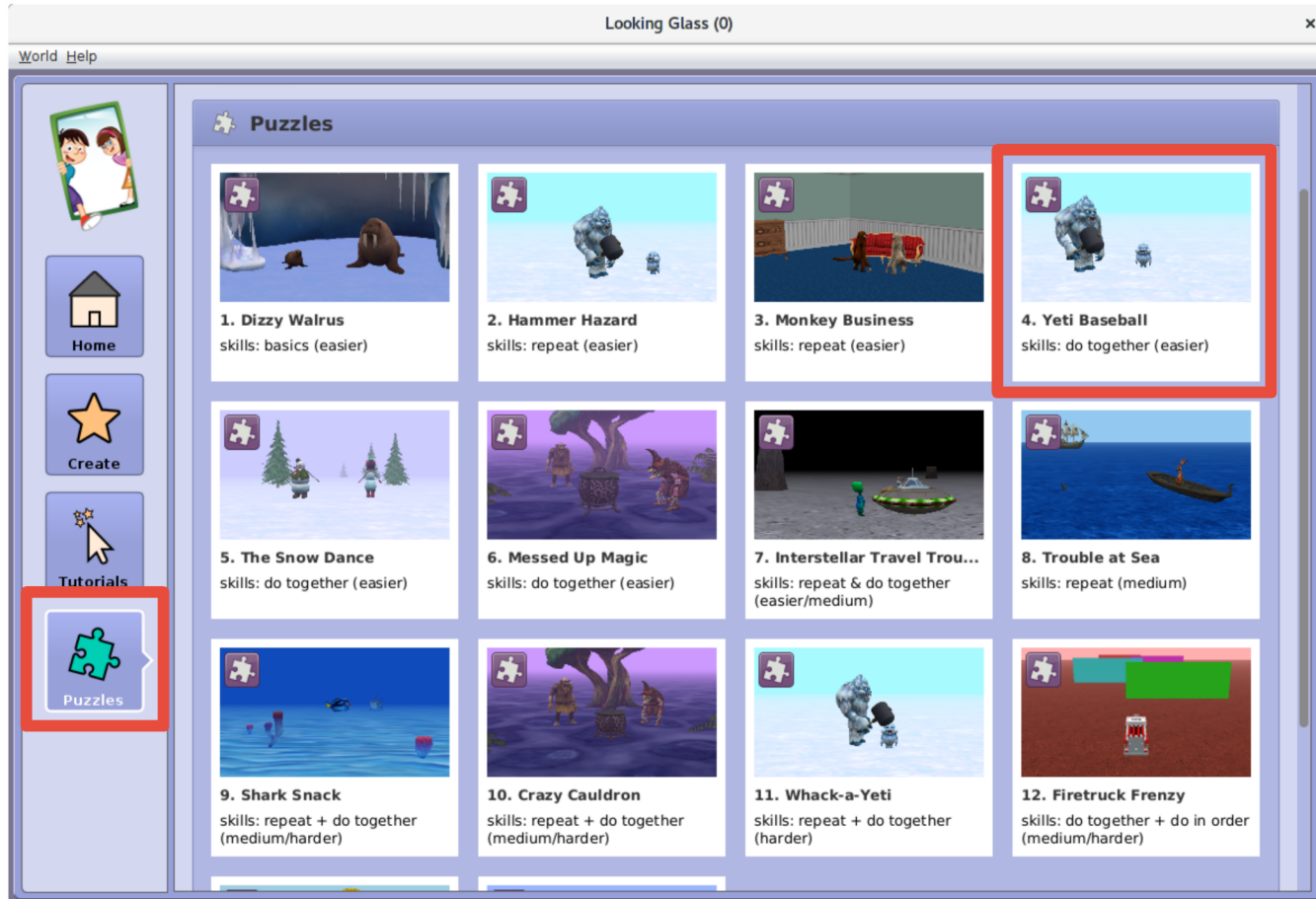
Drag in the following action:

tiny yeti turn to face big yeti.

Next »

2/12

Instructional Tasks: Puzzles



Instructional Format: Puzzle

Yeti Baseball - Looking Glass (0)

Undo Redo Reset Quit

The animation, Yeti Baseball, is all mixed up!
Using only the pieces you need, put the animation back in the correct order.

tiny yeti turn to face big yeti

Do together

- tiny yeti nod
- big yeti nod

tiny yeti move BACKWARD 0.5 meters

Do together

tiny yeti fly away

tiny yeti jump to hammer

big yeti wind up swing

big yeti power swing

Semi-Structured Interviews

Pre-Study Interview

“How would you rate your current programming or coding expertise? why?”

...

Post-Task Interviews (6)

“Was the experience of completing the tutorial/puzzle valuable to you in any way? why?”

“Did you learn anything new or did you acquire any new skills while doing the tutorial/puzzle?”

...

Post-Study Interview

“When is it better to to use tutorials/puzzles on your own? why?”

...



Exploratory Study: Data Summary

Instructional Tasks (167)

62 tutorials

105 puzzles

Responses

3,915 interview question responses

Average 40.2 minutes per participant

Research Questions

What decisions do users make?

Are code puzzles more motivating than tutorials?

What are users perceptions of value for each instructional format?

**Puzzles or
Tutorials?**



Instructional Format Decisions (Exclusively* X)

3% - exclusively tutorials
 $*(\geq n - 1)$

23% - exclusively puzzles
 $*(\geq n - 1)$

73% - both tutorials & puzzles

10% - more tutorials



20

Research Questions

What decisions do users make?

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**Both!
Puzzles &
Tutorials!**



Research Questions

What decisions do users make?

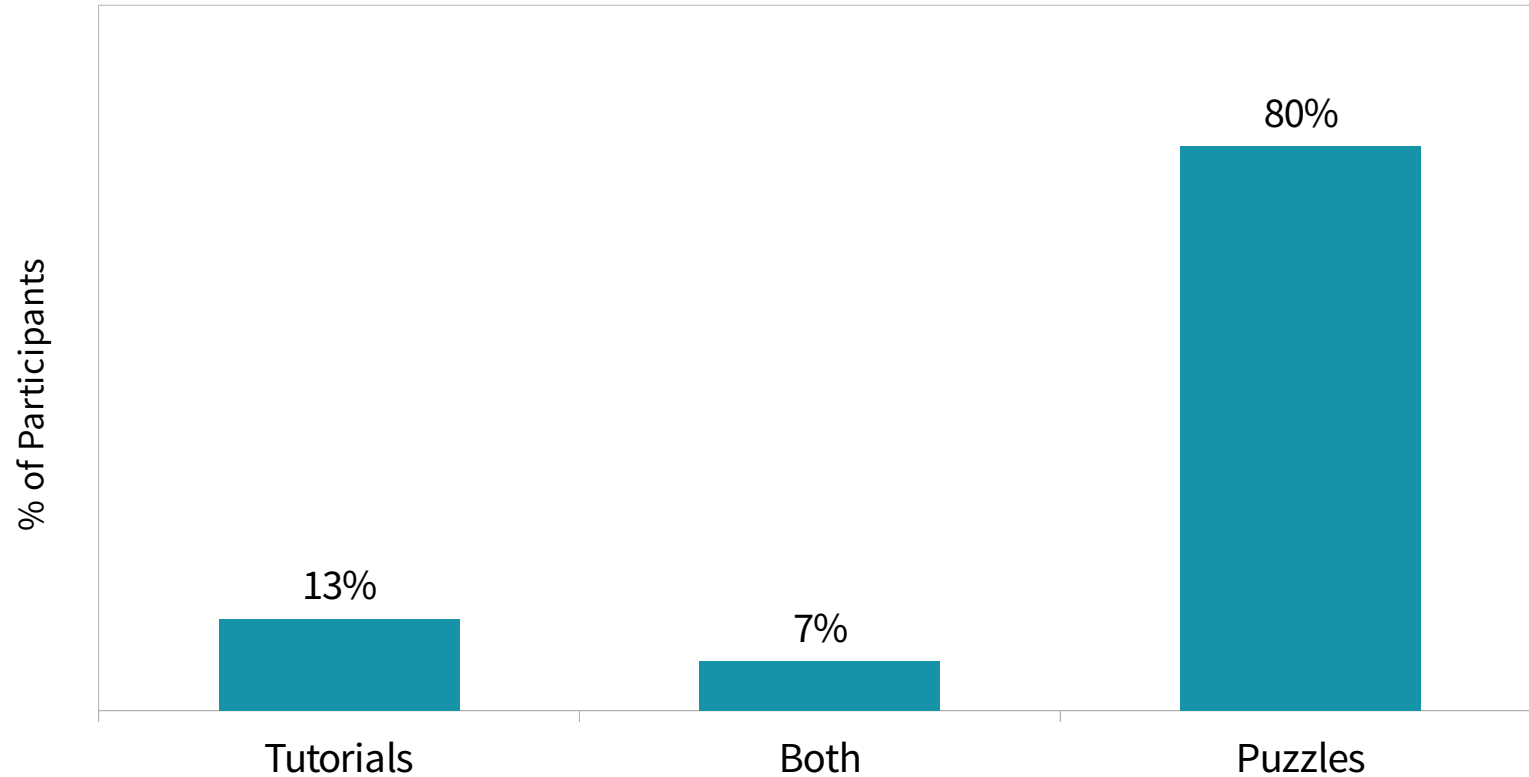
Are code puzzles more motivating than tutorials?

What are users perceptions of value for each instructional format?



Post-Study Interview: Which do you enjoy more?

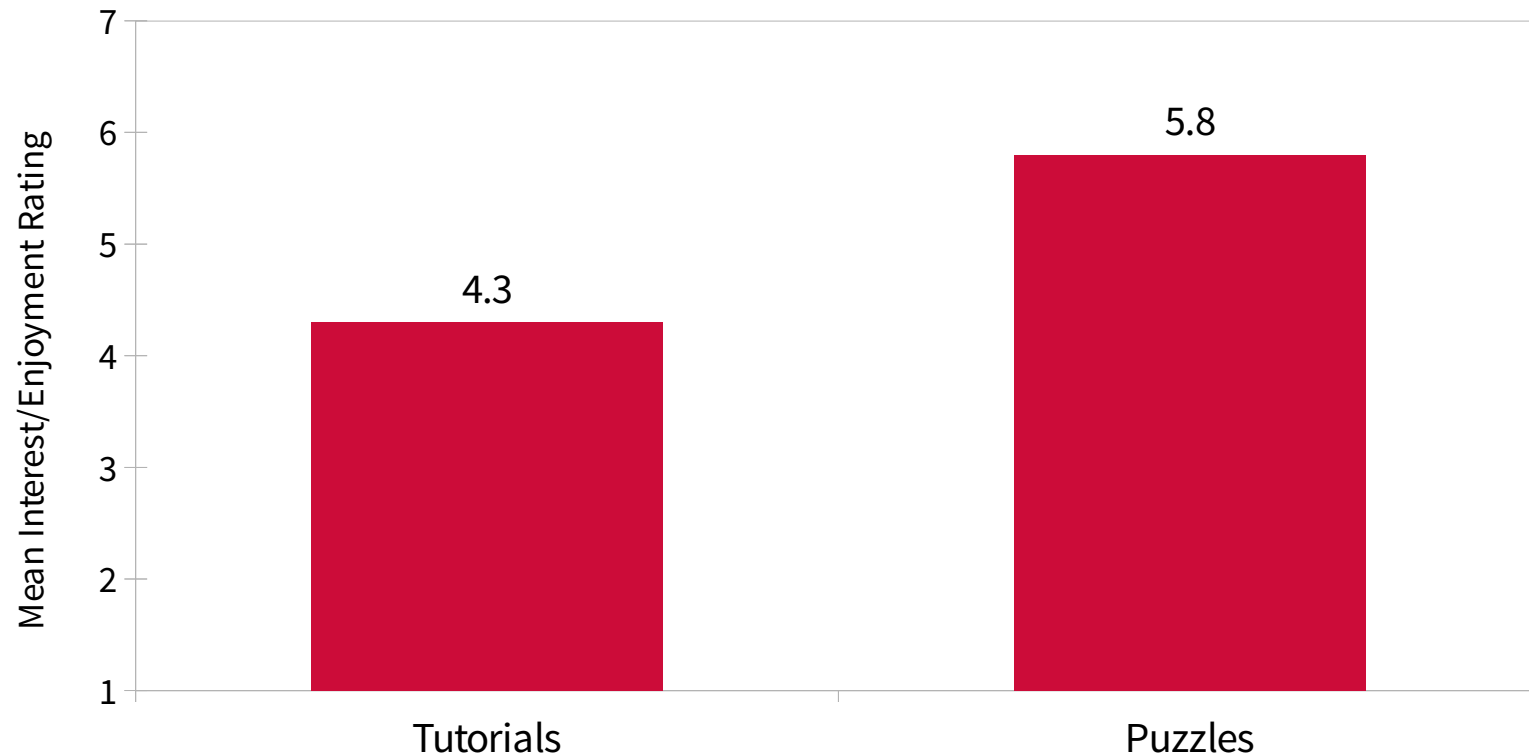
Post-Study Enjoyment Preference Response for Instructional Format



Intrinsic Motivation Inventory Survey: Interest/Enjoyment Subscale

$p < .001$

Mean Interest/Enjoyment for Tutorials & Puzzles



Research Questions

What decisions do users make?

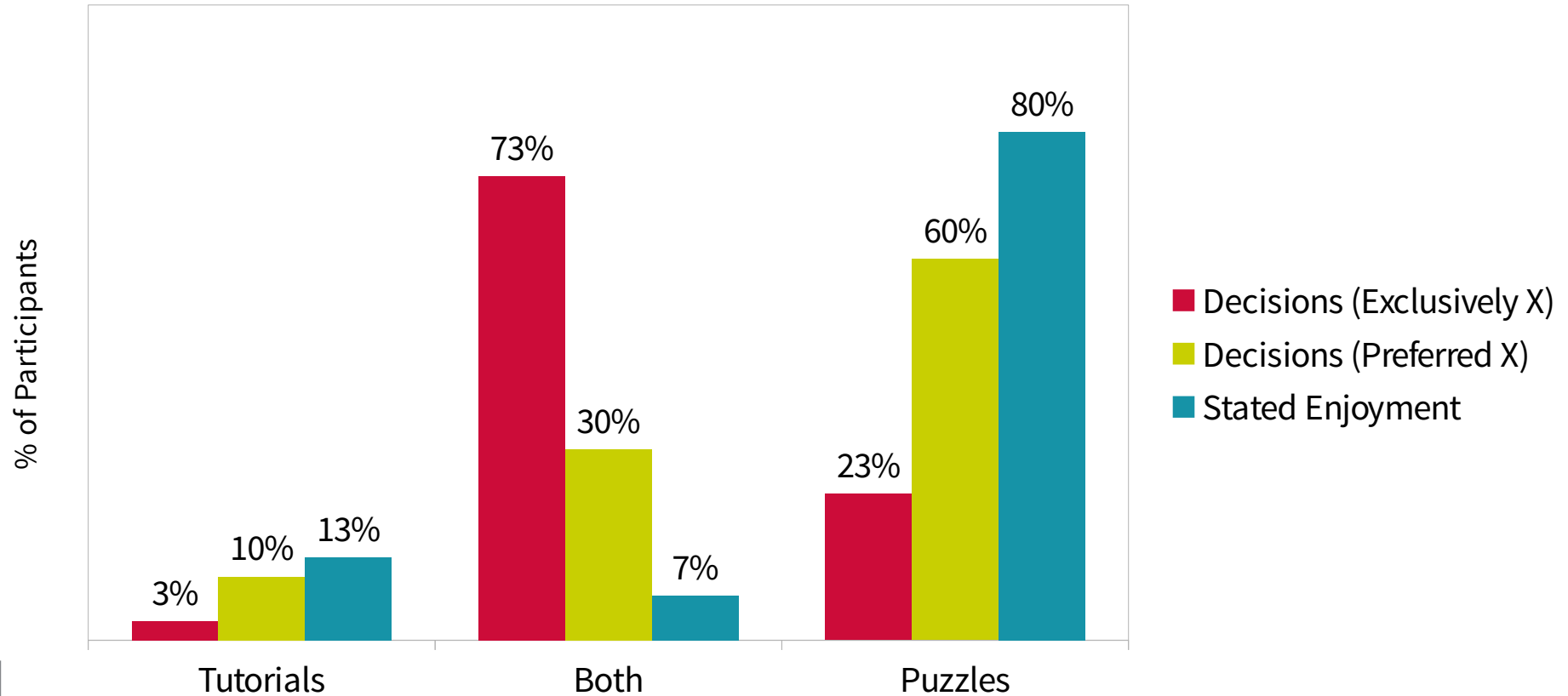
Are code puzzles more motivating than tutorials?

What are users perceptions of value for each instructional format?

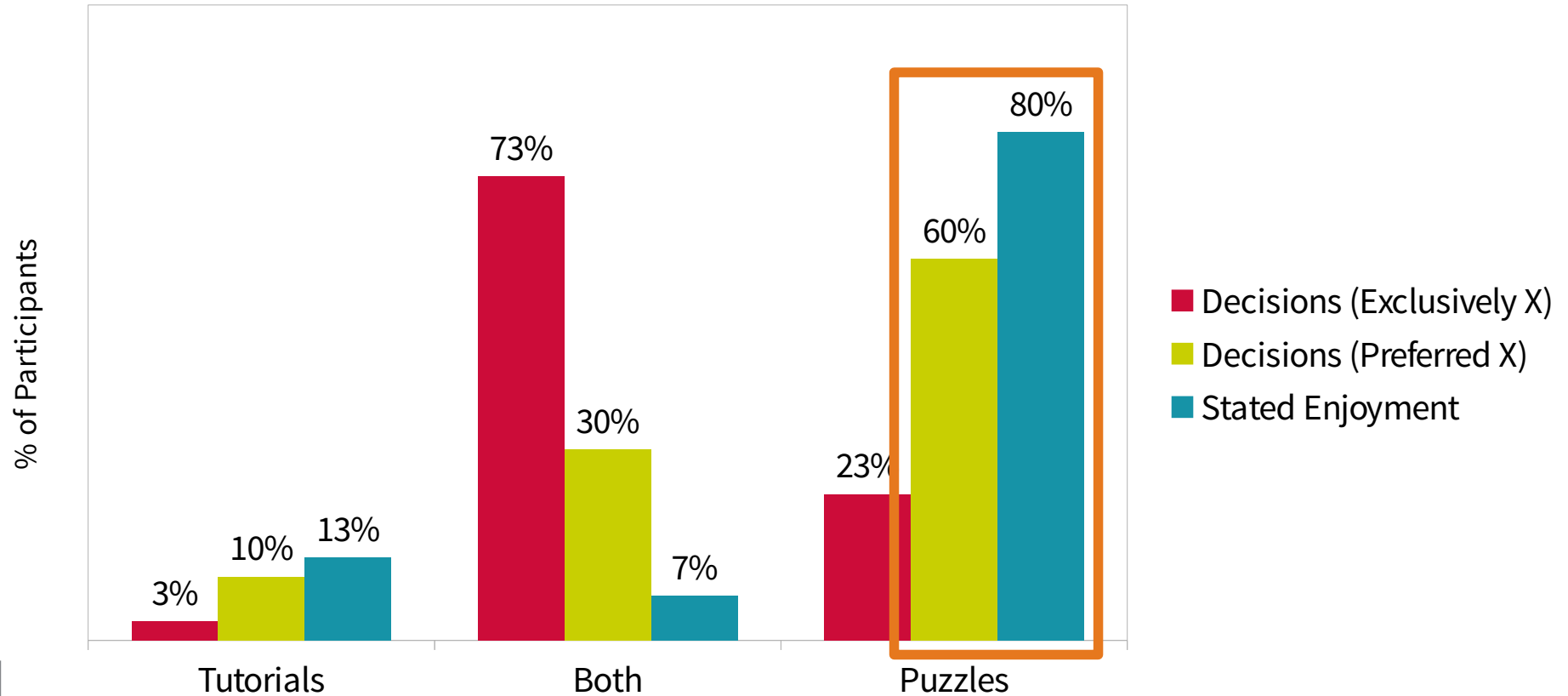
Puzzles!



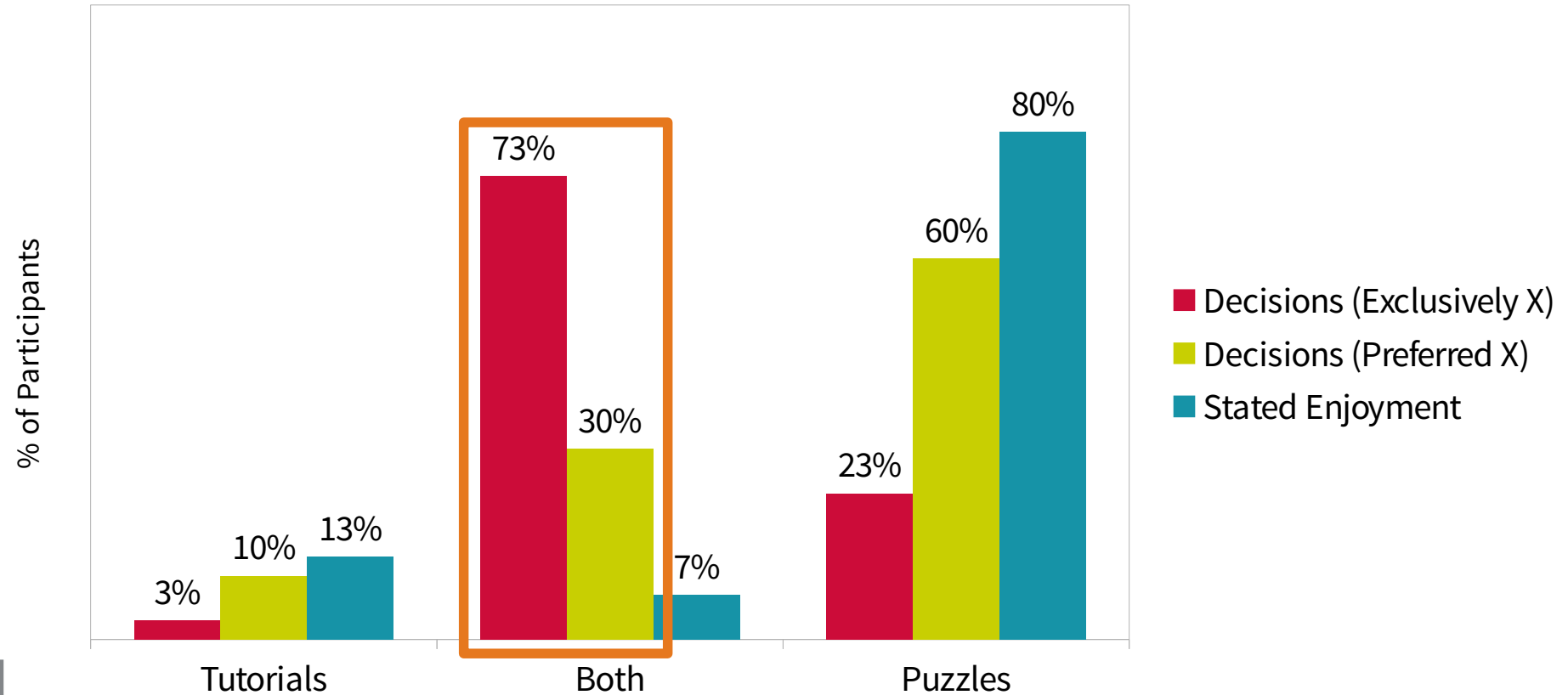
Decisions vs. Stated Enjoyment



Decisions vs. Stated Enjoyment



Decisions vs. Stated Enjoyment

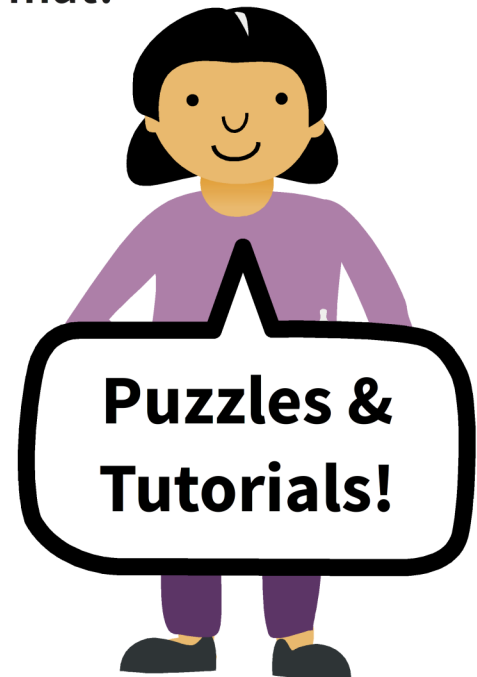


Research Questions

What decisions do users make and why?

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Exploratory Study: Data Summary

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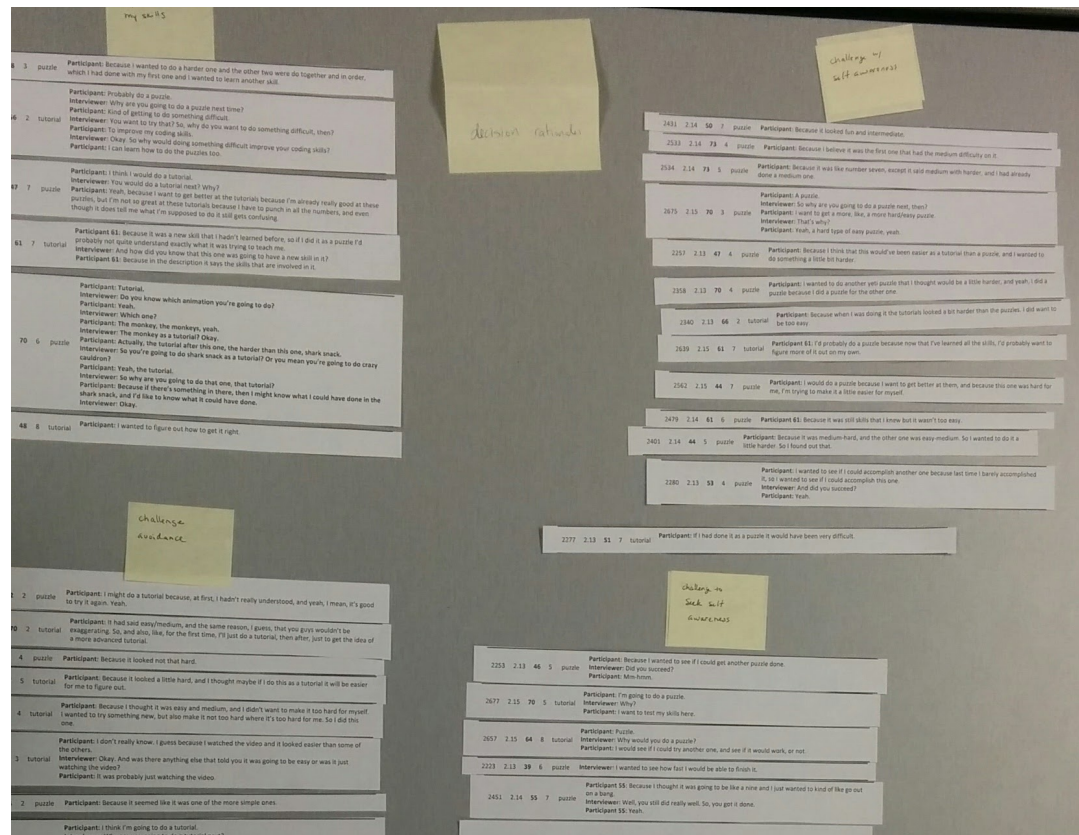
31



Response Analysis – Interrator Agreement

	Cohen's K	<i>p</i>
High-Level Categories	.95	$p < .001$
Decision Rationales		
Experience Outcomes		
Expected Task Difficulty		
Sources of Ease & Difficulty		

2nd Round: Category Sub-labels (Themes)



Decision Rationales Sub-labels

High-Level Category Themes – Interrator Agreement

	Cohen's K	<i>p</i>
High-Level Categories	.95	$p < .001$
Decision Rationales	.89	$p < .001$
Experience Outcomes	.86	$p < .001$
Expected Task Difficulty	.85	$p < .001$
Sources of Ease & Difficulty	.88	$p < .001$

Decision Rationale Themes

	Cohen's K	<i>p</i>
High-Level Categories	.95	$p < .001$
Decision Rationales	.89	$p < .001$
<div> <div>Personal Preference</div> <div>Improve Programming Skills</div> <div>Challenge</div> </div> <div>Experiences</div>		$p < .001$
<div> <div>Personal Preference</div> <div>Improve Programming Skills</div> <div>Challenge</div> </div> <div>Expected Outcomes</div>		$p < .001$
Sources of Ease & Difficulty	.88	$p < .001$

Decision Rationale Themes

Personal Preference

Improve Programming Skills

Challenge

Enjoyed Animation

“Probably just because it looked like a fun animation to do.”



83% of participants enjoyed the animation

Decision Rationale Themes

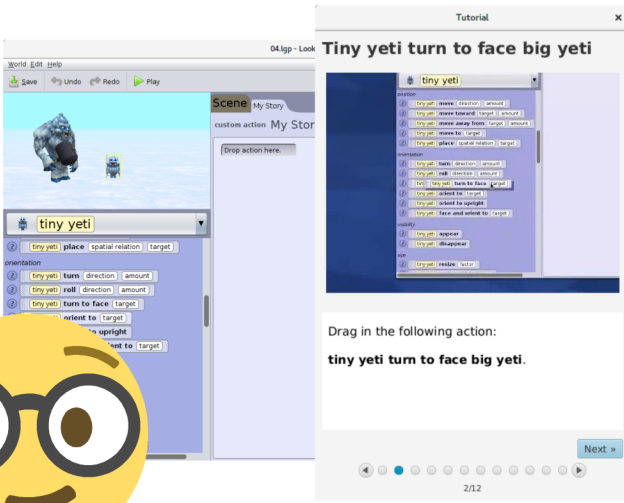
Personal Preference

Improve Programming Skills

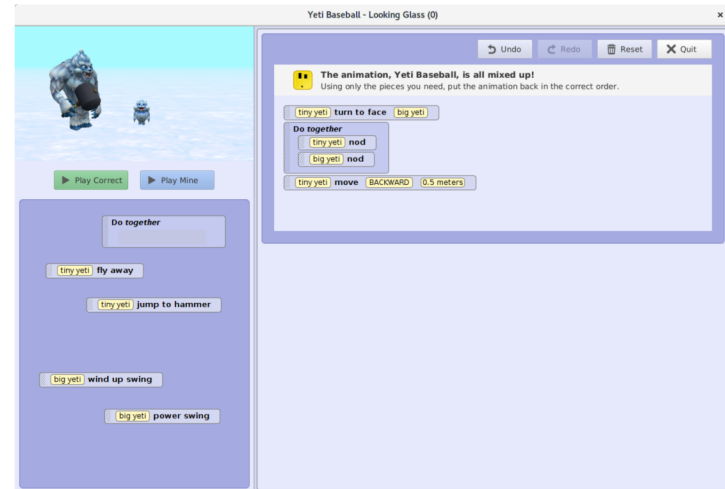
Challenge

Improve Programming Skills

“Because it was a new skill that I hadn't learned before, so if I did it as a puzzle I'd probably not quite understand exactly what it was trying to teach me.”



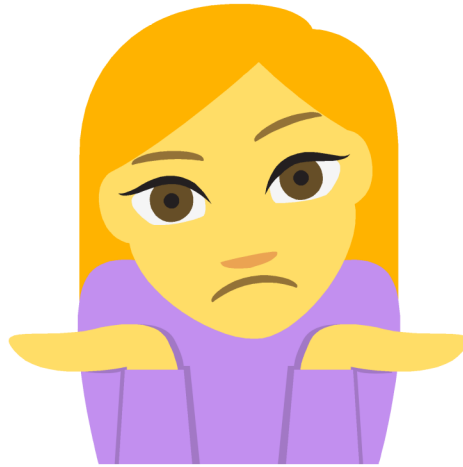
Choose Tutorial
19% of Tasks



Choose Puzzle
7% of Tasks

Discover Skill Level

“I wanted it to be a little harder than the tutorial because I wanted to see if it'd make a big difference or not.”



Discover Skill Level
21% of Tasks

Decision Rationale Themes

Personal Preference

Improve Programming Skills

Challenge

Challenge – Pushing Your Abilities



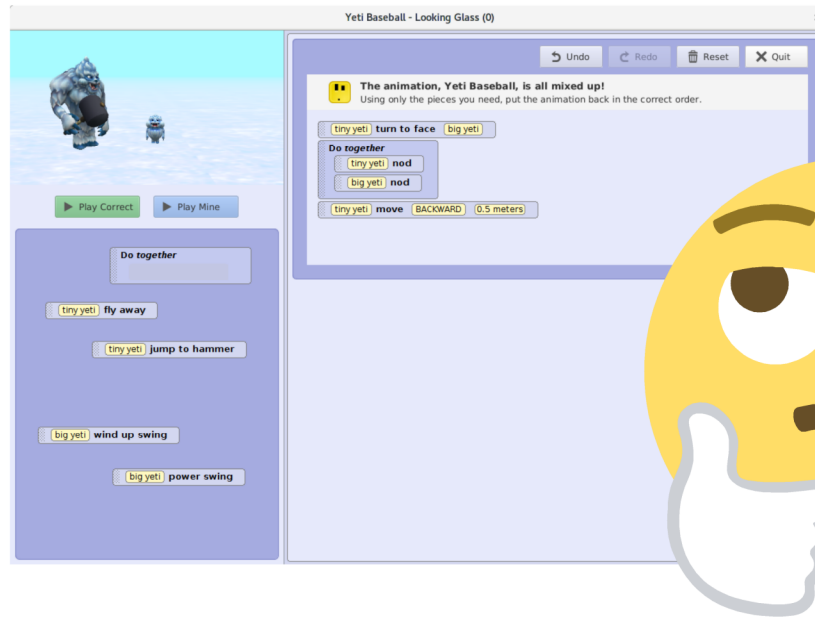
Sought Challenge
87% of Participants



Avoided Challenge
60% of Participants

Seeking Challenge

“I like having to challenge my mind more.”



57% of participants chose puzzles
32% chose tutorials

Avoiding Challenge – Do Something Easier

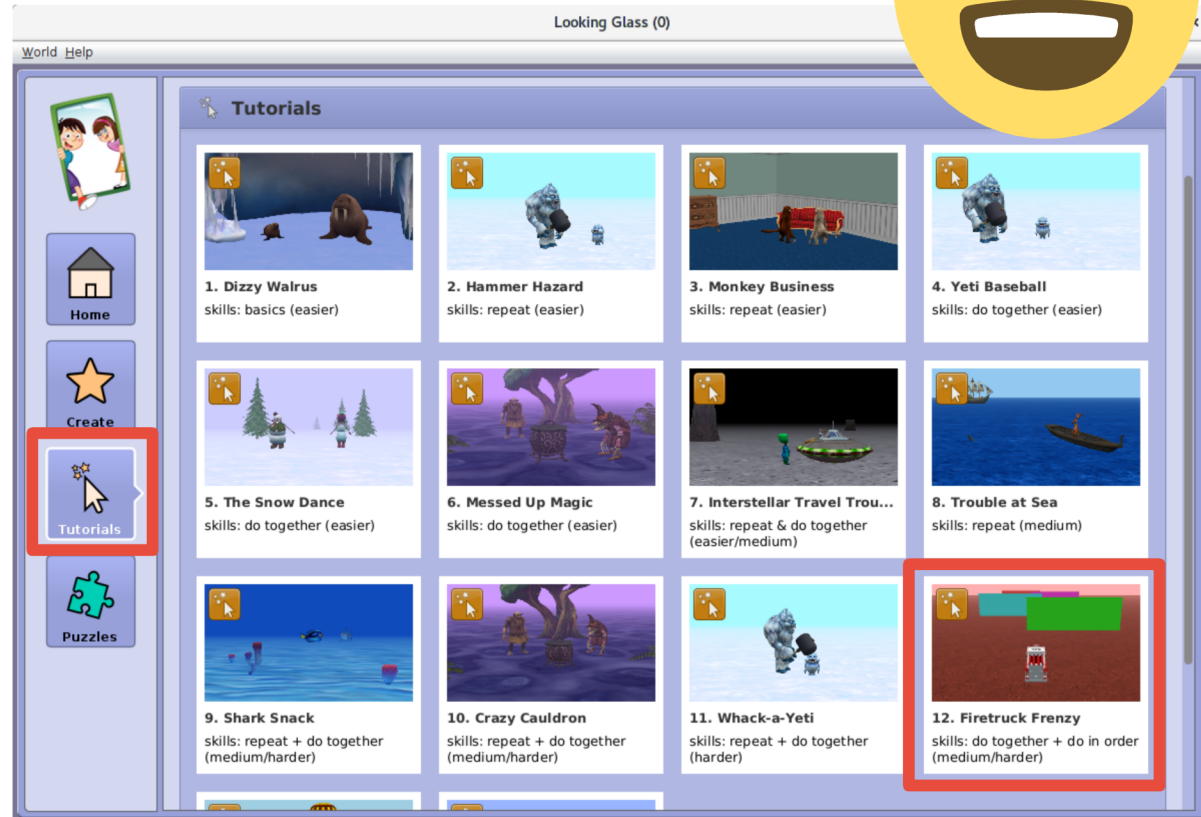


“I think I'm going to do mostly tutorials from now on because this was a bit hard.”

39% of participants chose tutorials
12% chose puzzles

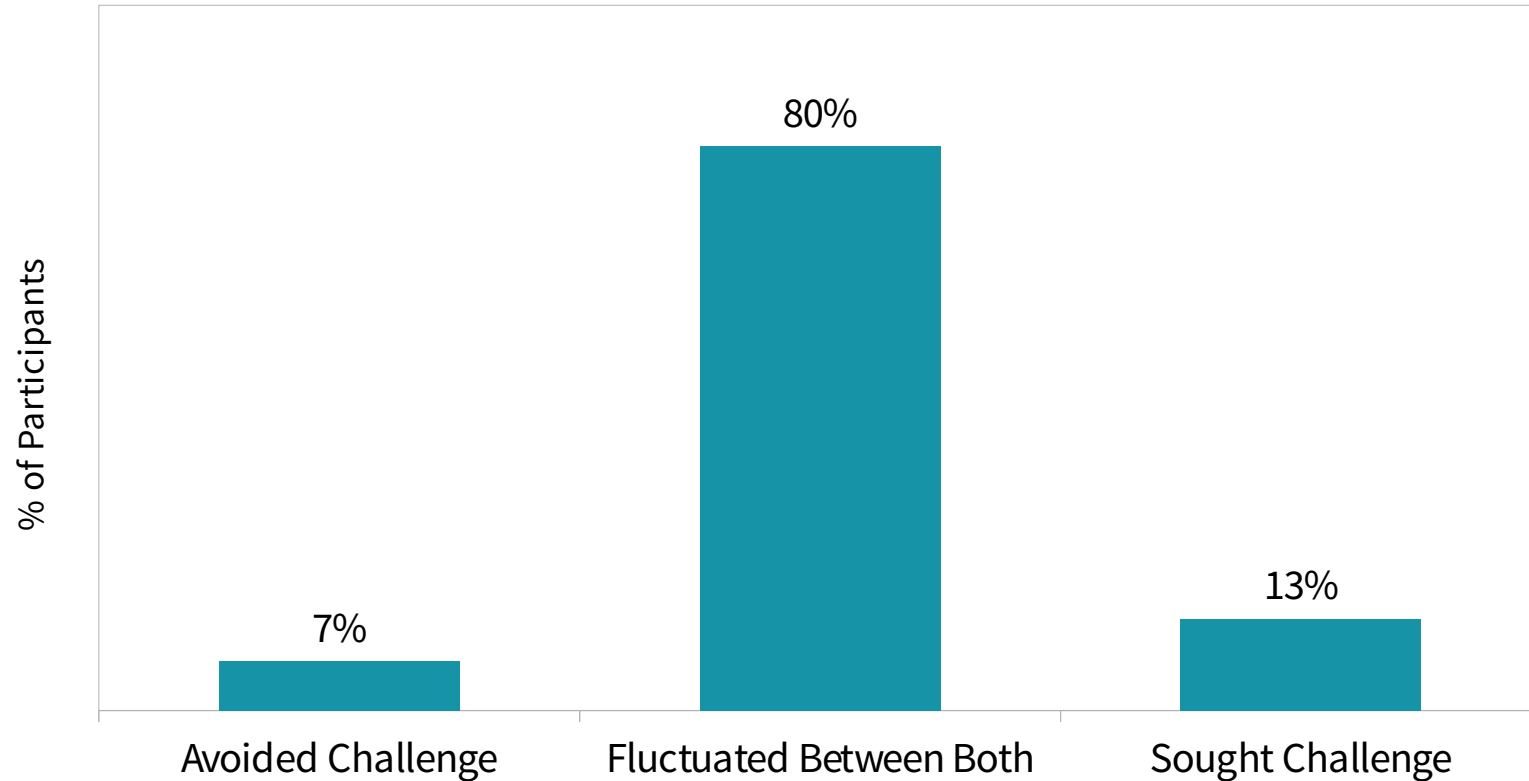
Avoiding Challenge – Motivating Animation

“I picked it as a tutorial because it looked like it had lots more complexity than the other ones and I didn't want to just jump right in without knowing what I was doing.”



Challenge Seeking/Avoidance Strategy

Challenge Strategy Throughout Instructional Tasks (6)

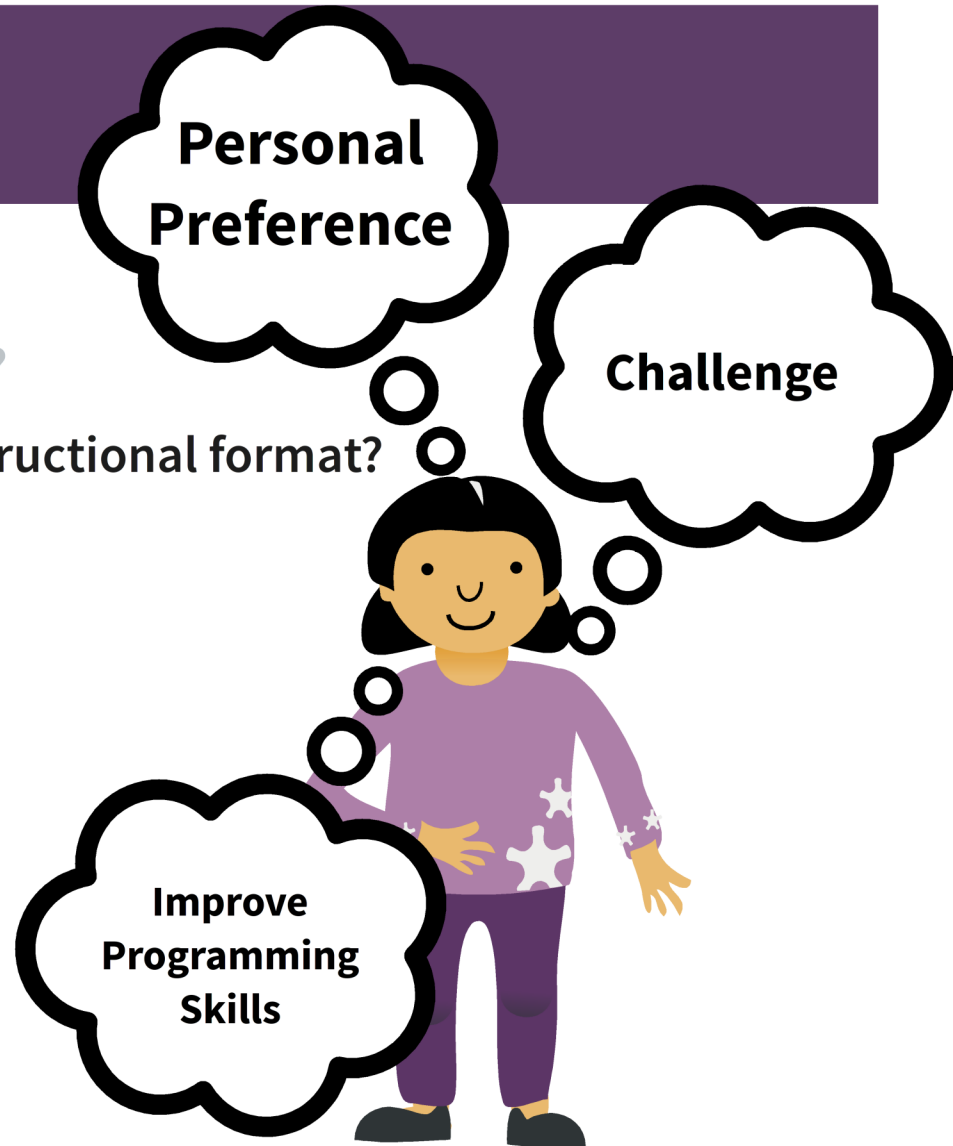


Research Questions

What decisions do users make?

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Considerations for Independent Learning Support in Novice Programming Environments

Support Multiple Levels of Challenge

Support Skill Level Discovery

Leverage Motivation + Provide Choice

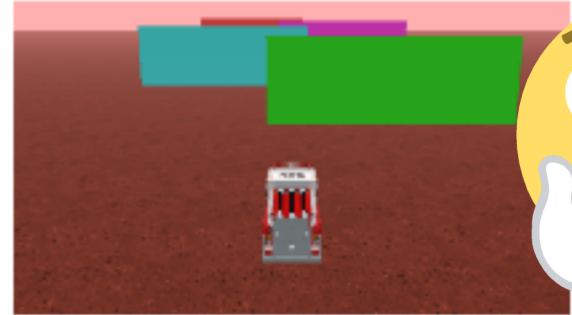


Support Multiple Levels of Challenge



1. Dizzy Walrus

skills: basics (easier)



12. Firetruck Frenzy

skills: do together + do in order
(medium/harder)



Support Skill Level Discovery



1. Dizzy Walrus

skills: basics (easier)



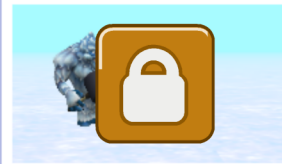
2. Hammer Hazard

skills: repeat (easier)



3. Monkey Business

skills: repeat (easier)



4. Yeti Baseball

skills: do together (easier)



5. The Snow Dance

skills: do together (easier)



6. Messed Up Magic

skills: do together (easier)



7. Interstellar Travel Trou...

skills: repeat & do together (easier/medium)



8. Trouble at Sea

skills: repeat (medium)



9. Shark Snack

skills: repeat + do together (medium/harder)



10. Crazy Cauldron

skills: repeat + do together (medium/harder)



11. Whack-a-Yeti

skills: repeat + do together (harder)



12. Firetruck Frenzy

skills: do together + do in order (medium/harder)



Leverage Motivation + Provide Choice



1. Dizzy Walrus
skills: basics (easier)



2. Hammer Hazard
skills: repeat (easier)



3. Monkey Business
skills: repeat (easier)



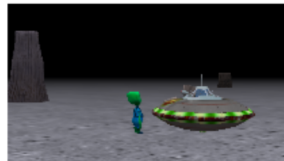
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5. The Snow Dance
skills: do together (easier)



6. Messed Up Magic
skills: do together (easier)



7. Interstellar Travel Troubles
skills: repeat & do together (easier/medium)



8. Trouble at Sea
skills: repeat (medium)



9. Shark Snack
skills: repeat + do together (medium/harder)



10. Crazy Cauldron
skills: repeat + do together (medium/harder)



11. Whack-a-Yeti
skills: repeat + do together (harder)



12. Firetruck Frenzy
skills: do together + do in order (medium/harder)



This animation is
challenging

Follow a Tutorial

Solve a Puzzle

?

?

Questions

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Washington University in St. Louis

