

UIC 2022

Project Co-Art: Improving Children's Imagination Through AI-based Human-Computer Co-creation



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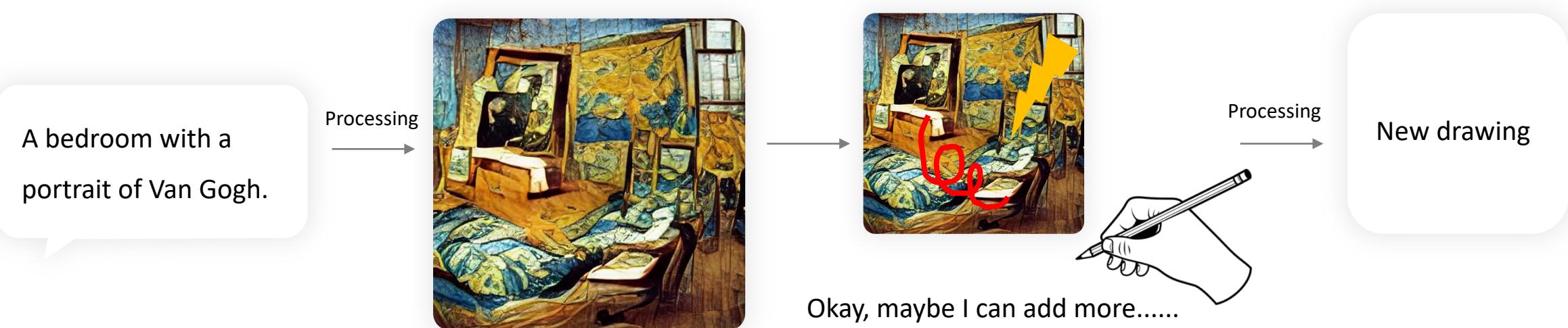
Introduction

1 Introduction

Co-Art is a drawing education system that can foster children's imagination through AI-based human-computer co-creation.

It can understand the sentence described by the child and visualize it in an abstract style.

The machine's artwork can inspire the child to create a second version.

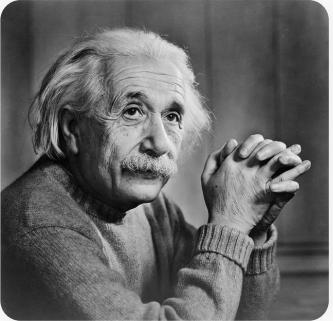


Related Work

- 1. Children's Imagination**
- 2. Drawing Education and Imagination Improvement**
- 3. Artificial Intelligence for Drawing**

2-1 Children's Imagination

1) Imagination is often associated with innovation but it decreases as children grow.



Einstein

“Imagination is more important than knowledge because knowledge is limited, whereas imagination encapsulates the world, drives progress, and is the source of the evolution of knowledge.”

In 1968, Paul Torrance found that a large proportion of children experience a decrease in their divergent thinking scores beginning around the age of 9-10 (around Grade 4).

In 2010, Sing Lau and Ping Chung Cheung tested a sample of 2,476 Grade 4 to 9 Chinese school children, and observed the creativity scores dropped from Grade 5 to 7.

2-1 Children's Imagination

2) Imagination can be trained through artistic activities.



Play



Creative writing

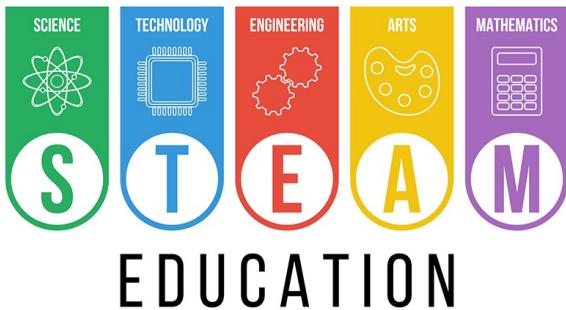


Theatrical creativity



Drawing

According to L.S. Vygotsky's research in 2004, imaginative skills can be trained through artistic activities



STEAM education model, which has been popular for several years, allows students to link their learning in these key areas with artistic practices and design guidelines to stimulate imagination and creativity.

2-2 Drawing Education and Imagination Improvement

with
teacher

Feedback



Hualeme

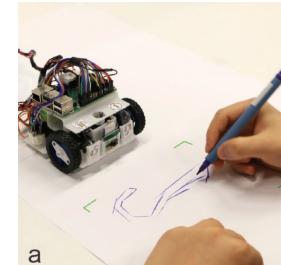


Bear Art

Collaboration



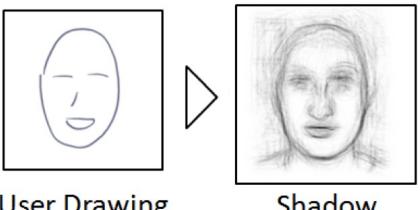
Social robotic peer



Cobbie

with
robot

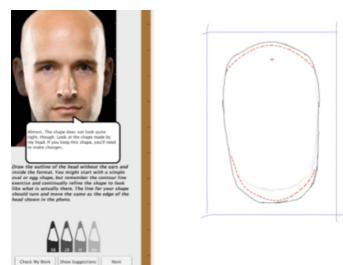
with
AI



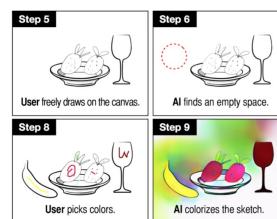
User Drawing

Shadow

ShadowDraw



iCanDraw



DuetDraw



Drawing Apprentice



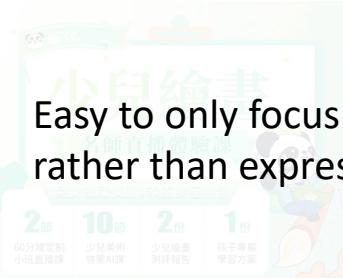
StoryDrawer

with
AI

2-2 Drawing Education and Imagination Improvement

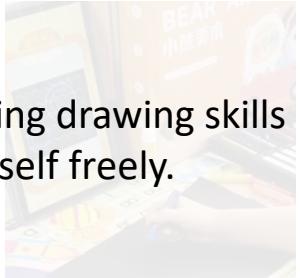
Feedback

with
teacher



Easy to only focus on learning drawing skills rather than expressing oneself freely.

Hualeme



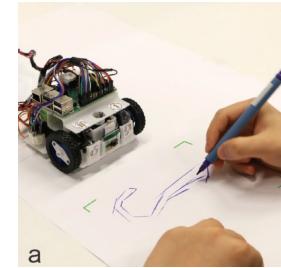
Bear Art

Collaboration

with
robot



Social robotic peer



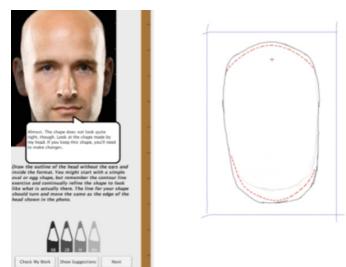
Cobie

with
AI

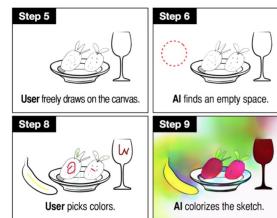


User Drawing Shadow

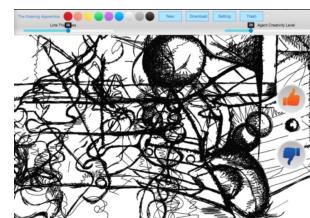
ShadowDraw



iCanDraw



DuetDraw



Drawing Apprentice



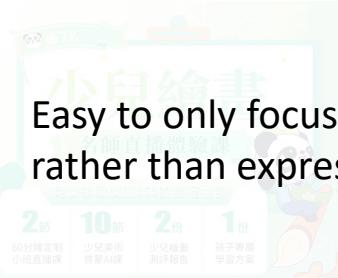
StoryDrawer

with
AI

2-2 Drawing Education and Imagination Improvement

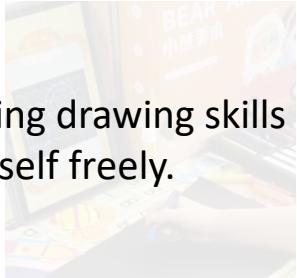
Feedback

with
teacher



Easy to only focus on learning drawing skills rather than expressing oneself freely.

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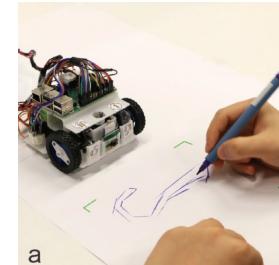
Bear Art

Collaboration

with
robot

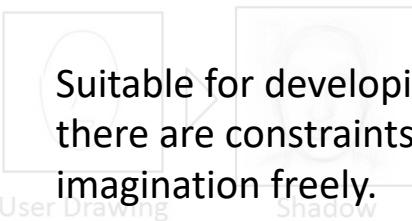


Social robotic peer



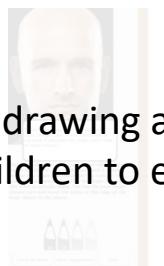
Cobie

with
AI



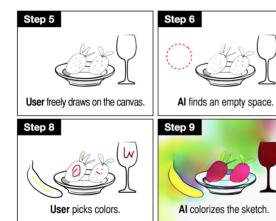
Suitable for developing the drawing ability, but there are constraints for children to expand their imagination freely.

ShadowDraw

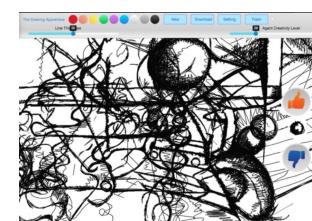


iCanDraw

with
AI



DuetDraw



Drawing Apprentice

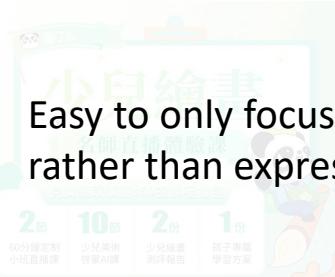


StoryDrawer

2-2 Drawing Education and Imagination Improvement

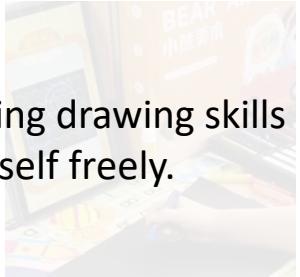
Feedback

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Easy to only focus on learning drawing skills rather than expressing oneself freely.

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Bear Art

Collaboration

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robot



Social robotic peer



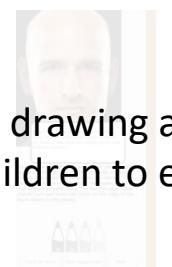
Cobbie

with
AI

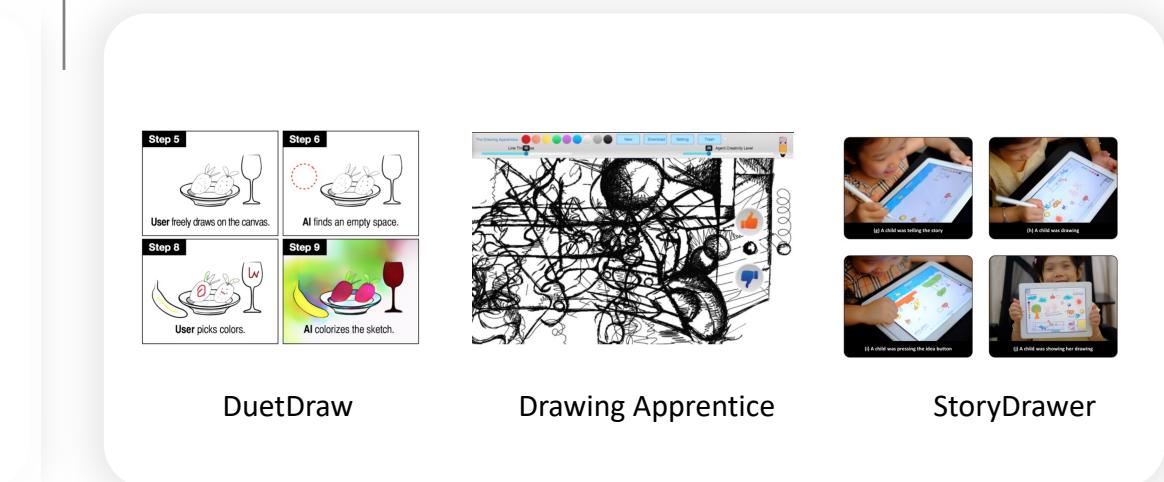


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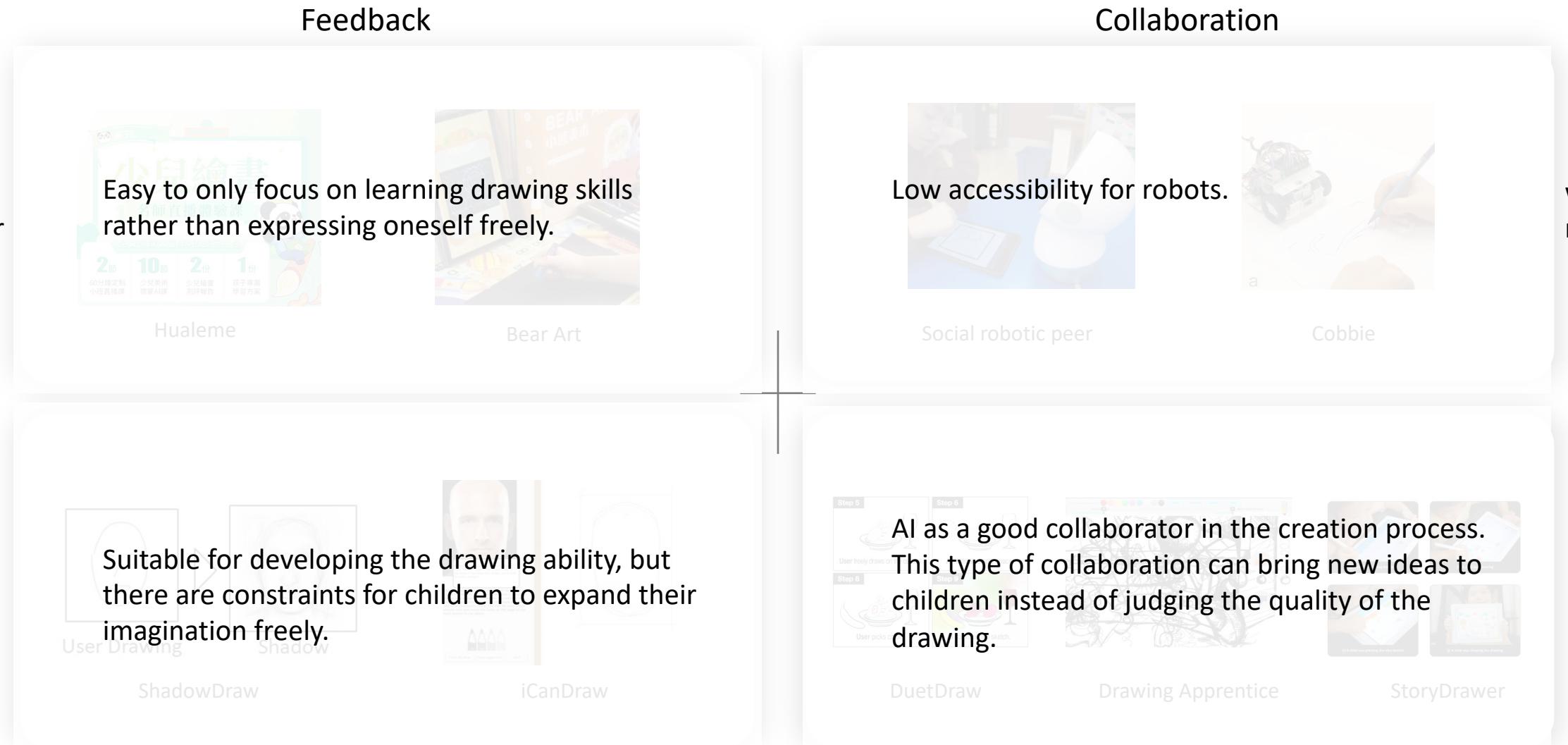


iCanDraw

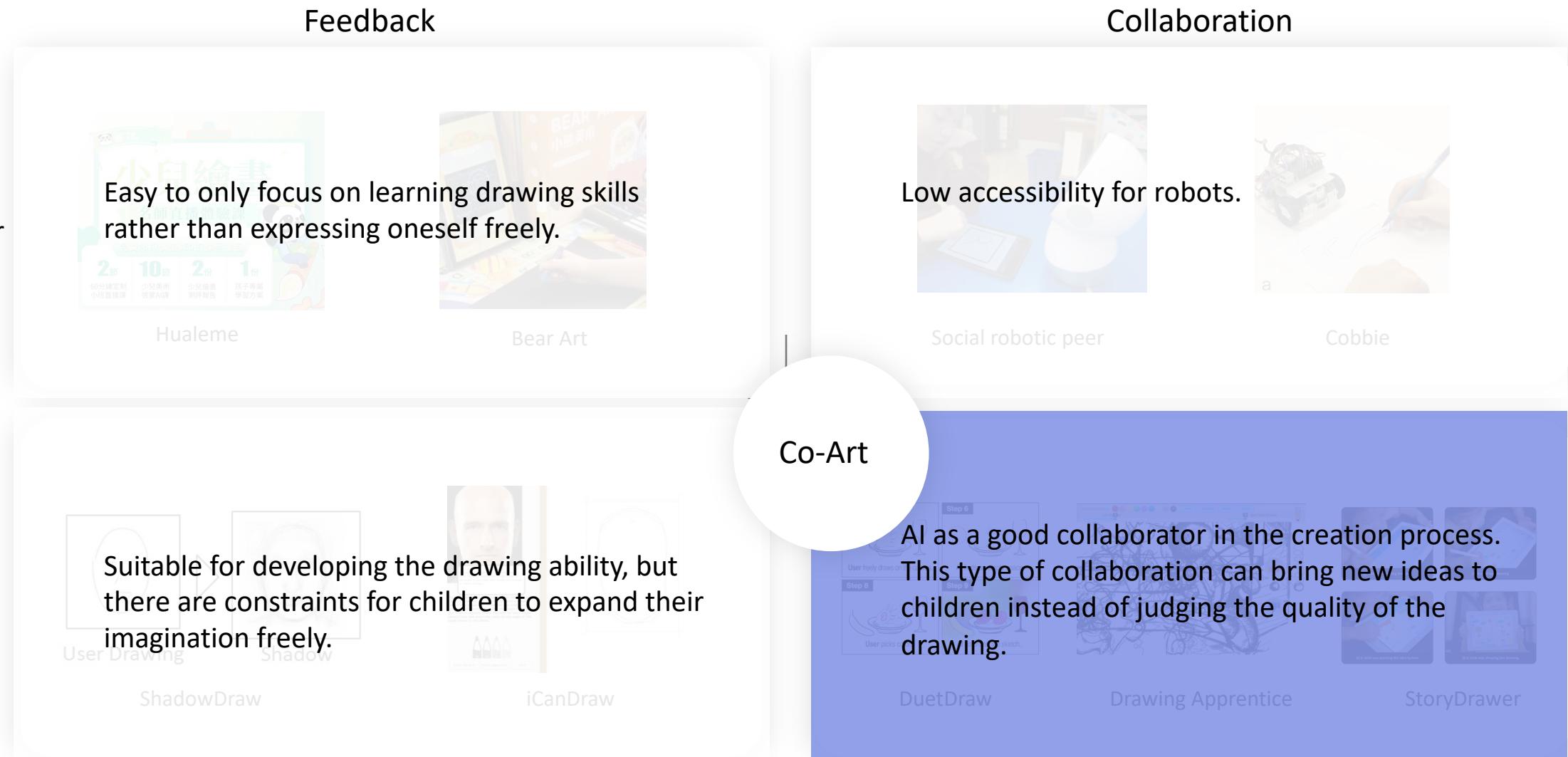


with
AI

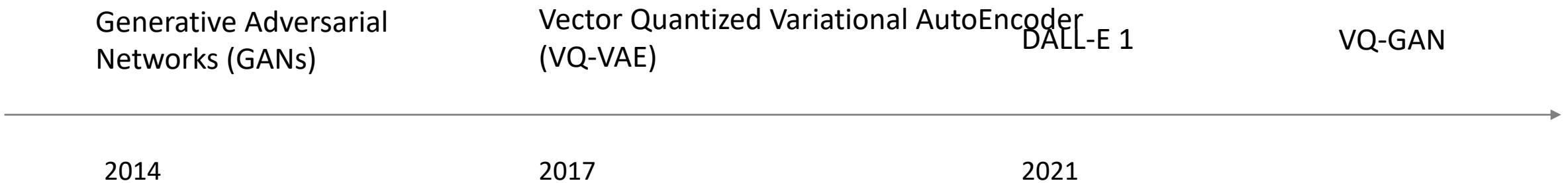
2-2 Drawing Education and Imagination Improvement



2-2 Drawing Education and Imagination Improvement



2-3 Artificial Intelligence for Drawing



In this research, we used the VQ-GAN model to generate a unique image that best approximates the painting theme based on the images matched by the CLIP model.

03

System Design

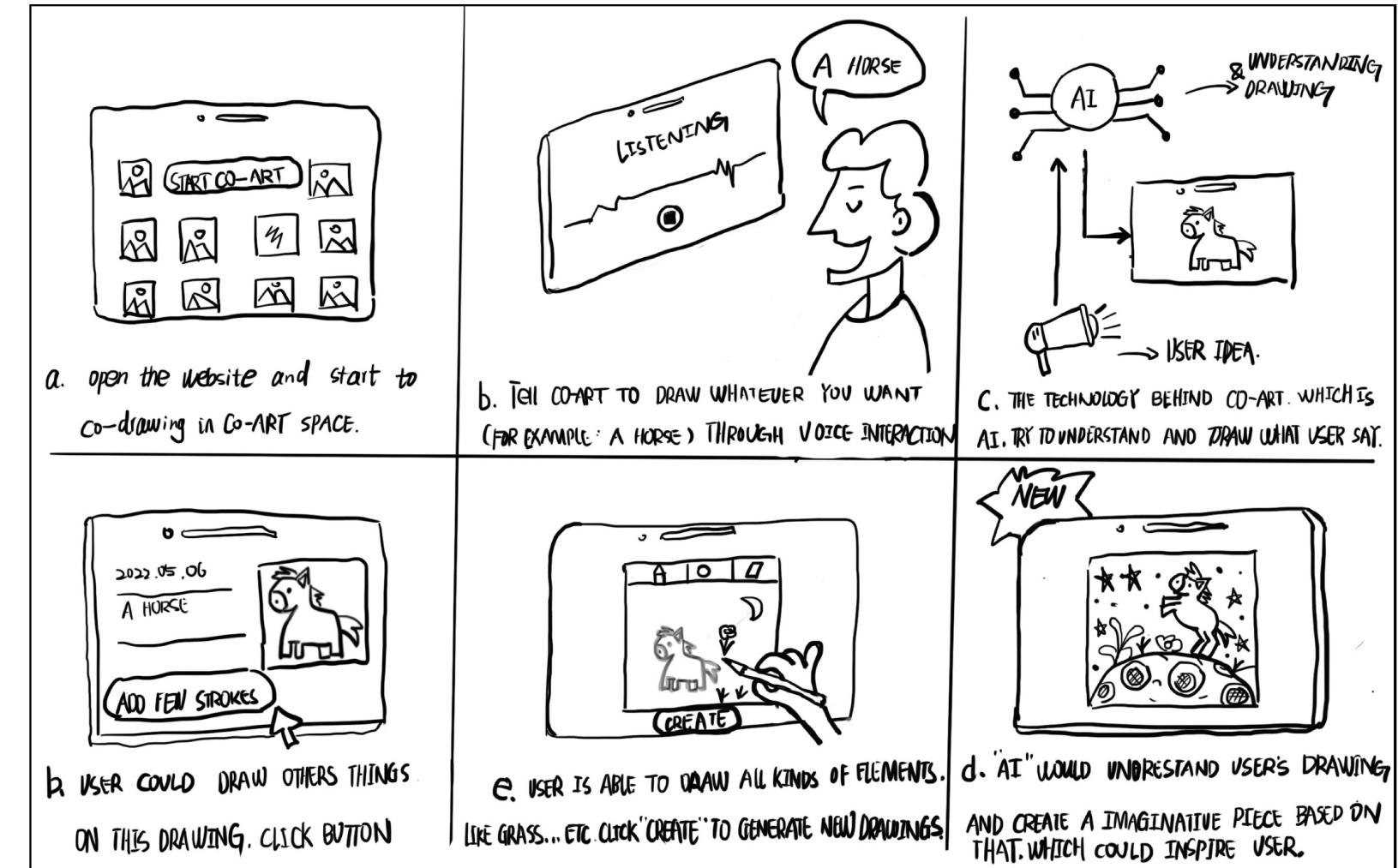
- 1. User Experience Design**
- 2. Software Design**

3-1 User Experience Design

Stage 1:



Describing the image

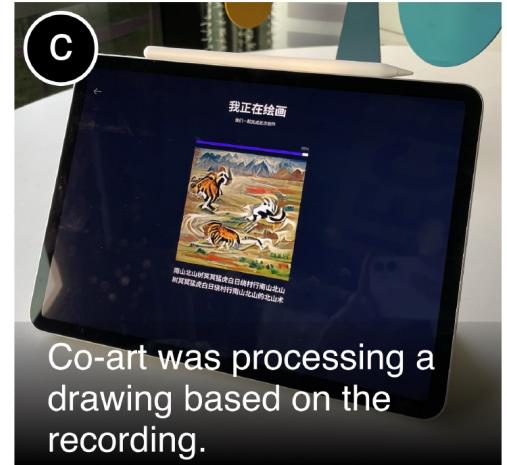
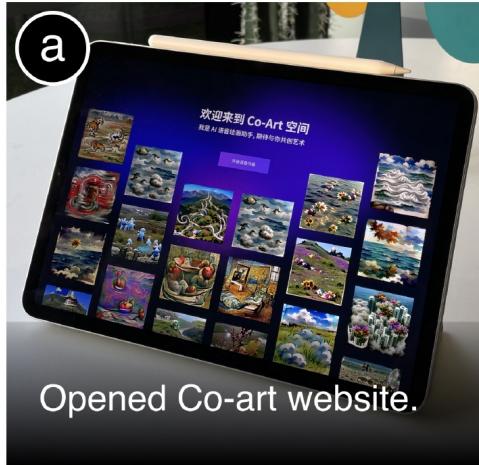


3-2 Software Design

All interactions are web-based and can be accessed through multiple device combinations.

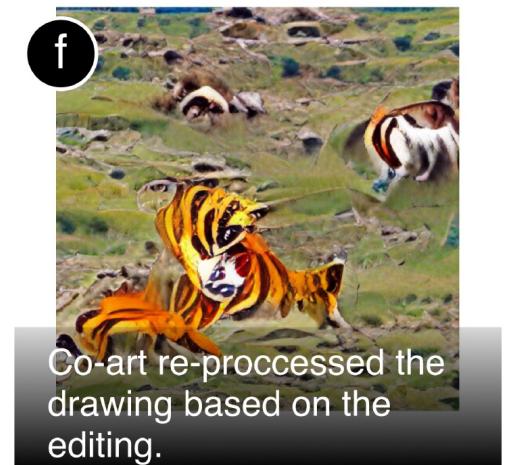
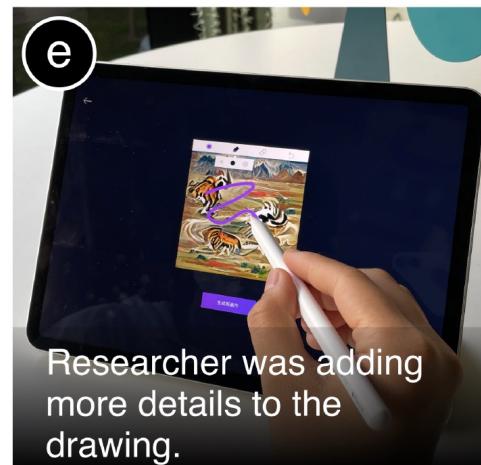
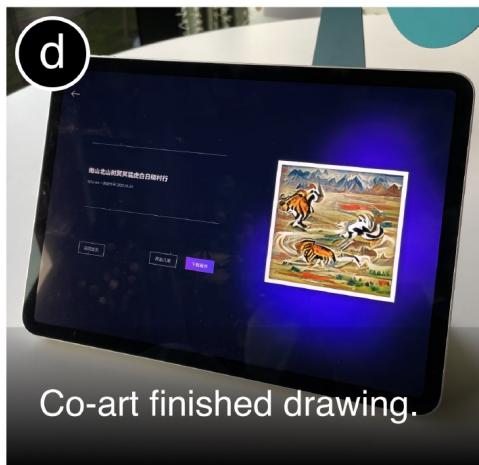
Stage 1:

Describing the image



Stage 2:

Editing and reproducing



User Study

- 1. Setting**
- 2. Measurement**
- 3. Results**

4-1 Setting

Goal

To prove the positive effects of the Co-Art system in developing children's imagination, we executed a comparative user test.

Subjects

20 participants came from Beijing, China (N = 20), 60% girls (N = 12), and 40% boys (N = 8), with an average age of 12 years.

Procedure

- 1) Subjects were introduced for the experiment, including privacy strategies.
- 2) Subjects' imagination was initially assessed via Williams Prefer Measurement Forms and divided equally into control and experimental groups based on scores so that each group had an equivalent level of imagination
- 3) Introduce the subjects to the system, allow them to try it out for 10 minutes afterward, and help them solve any problems that may arise during the trial.
- 4) After the experimental group has finished drawing, take a half-hour break and give them Theme A again, using paper and pen.
- 5) Experts in the field of children's drawing were invited to evaluate the drawings of both groups for Theme A.



4-2 Measurement

1) Williams Prefer Measurement Forms

The Williams Prefer Measurement Forms is a psychometric instrument that measures creative tendencies. The test has 50 questions, each followed by three response options: fully, partially, and not at all. There are four dimensions: [adventurousness, curiosity, imagination, and challenge](#). The higher the total score, the higher the level of creativity. [We focused on the imagination dimension in this research.](#)

2) Experimental Group & Control Group

	Experimental Group	Control Group
Step 1	Please choose any of the following keywords to create a sentence and a painting with Co-Art Martian, spaceship, black hole, rabbit, sun god, and monster.	-
Step 2	Please draw a painting about spring.	Please draw a painting about spring.

3) Expert's Evaluation

At the end of the test, we invited two experts with more than five years of experience in art education to evaluate children's drawings for theme A. The judges rated the children's drawings from three criteria: [aesthetics and richness, imagination and creativity, childishness and innocence](#), and five points per criterion.

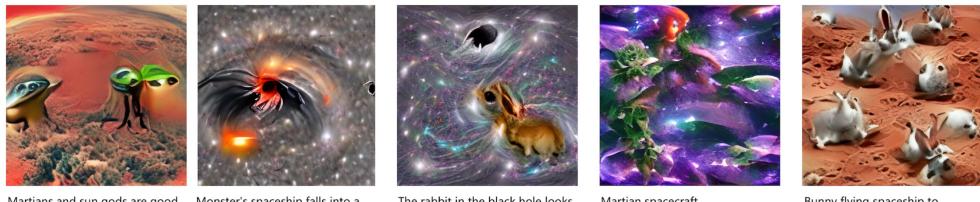
4-3 Results

Experimental Group

mean score for
Williams Prefer Measurement Forms : 26



There's a monster on top of the spaceship
Spacecraft entering a black hole
The pet of the cosmic sun god is a rabbit
Aliens fighting with monsters
The home of the Sun God lives in a black hole



Martians and sun gods are good friends
Monster's spaceship falls into a black hole
The rabbit in the black hole looks like a monster
Martian spacecraft
Bunny flying spaceship to Martian's house

Experimental Group Works for Theme B Created with Co-Art



Experimental Group Works for Theme A : A painting about spring

Control Group

mean score for
Williams Prefer Measurement Forms : 25



Control Group Works for Theme A : A painting about spring

4-3 Results

One-way analysis of variance (ANOVA) was used to perform statistical calculations on the scoring results. When $p<0.05$, the difference between the two groups is significant, and when $p<0.01$, the differences highly significant.

TABLE I
RESULTS OF EXPERT A'S SCORES

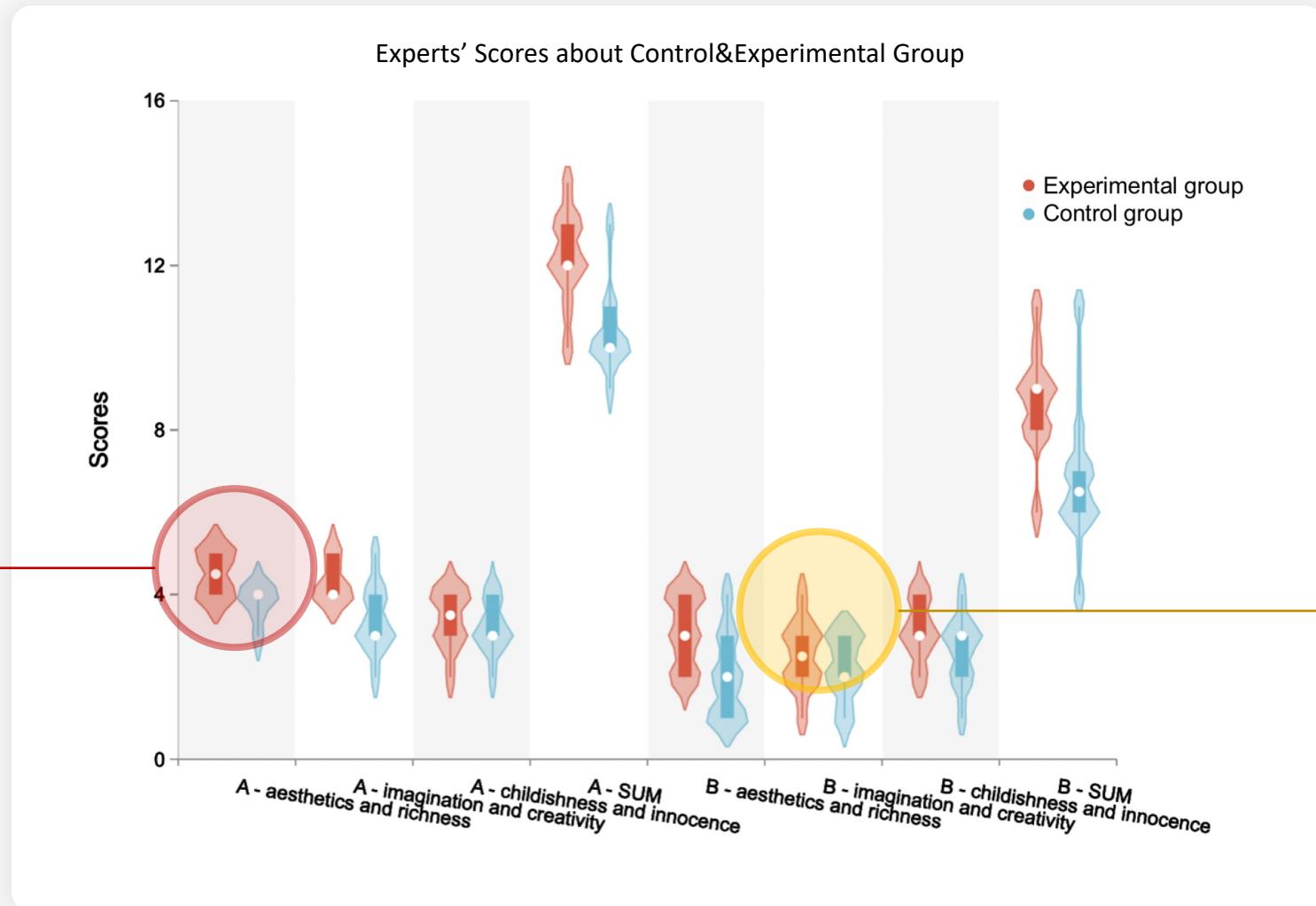
Dimension	SS	df	MS	F	P-value	F crit
aesthetics and richness	2.45	1	2.45	10.7560	0.0041	4.4138
imagination and creativity	4.05	1	4.05	8.5764	0.0089	4.4138
childishness and innocence	0.2	1	0.2	0.45	0.5108	4.4138

TABLE II
RESULTS OF EXPERT B'S SCORES

Dimension	SS	df	MS	F	P-value	F crit
aesthetics and richness	6.05	1	6.05	6.4437	0.0205	4.4138
imagination and creativity	1	1	0.45	0.6694	0.4239	4.4138
childishness and innocence	1.25	1	1.25	1.9911	0.1752	4.4138

4-3 Results

Overall the distribution of the experimental group's scores is **not lower than** that of the control group for both Expert A and Expert B.



Discussion

- 1. Analysis of Test Results**
- 2. Limitations & Future Plans**

5-1 Analysis of Test Results

1) Better aesthetics and richness

Aesthetics and richness, the two experts' scores showed a significant difference between the performance of the experimental and control groups, indicating that the children's drawings showed a better sense of beauty and richness after Co-Art training.

2) Small number of subjects led different opinions on imagination and creativity

Two experts had different opinions on imagination and creativity. One expert believes that the difference between the experimental group's performance and the control group's after the Co-Art training is highly significant, proving that Co-Art helps children improve their imagination and creativity. Another expert, however, had a different opinion and analyzed the scores to show no significant difference in the performance of the two groups, which could be related to the small number of subjects.

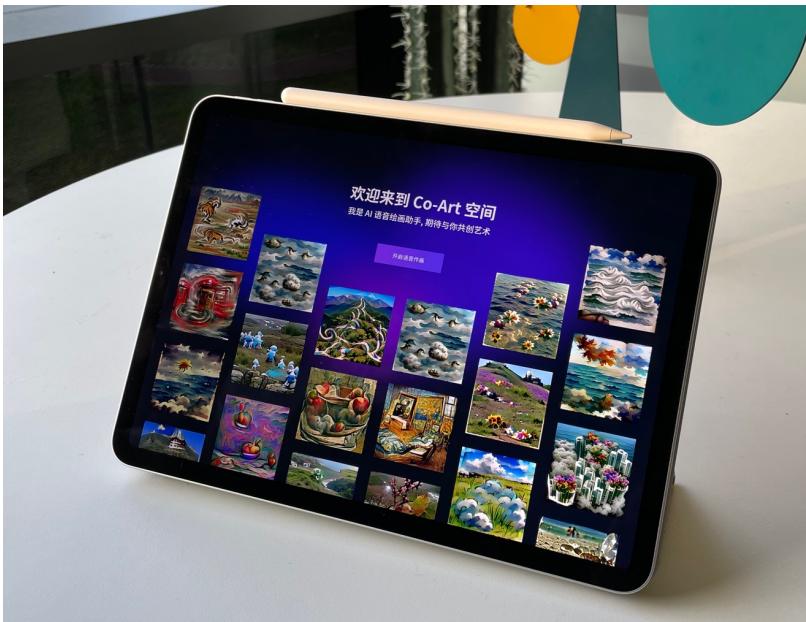
3) No different in performance of childness and innocence

There was no difference in performance between the control and experimental groups in the dimension of childness and innocence. This result is mainly consistent with reality, as childness and innocence are more related to age and stage of development

5-1 Limitations & Future Plan

1) Less attractive interface design for children

The interaction design of Co-Art could be enhanced in a targeted way for the habits and needs of children, thus increasing its appeal to children and improving the user experience.



2) Small subjects number for user study

Although we executed a user test for this paper, the number of subjects was relatively small. The reason is that COVID-19 made it challenging to find many children who met the requirements to be tested simultaneously.

Q & A