



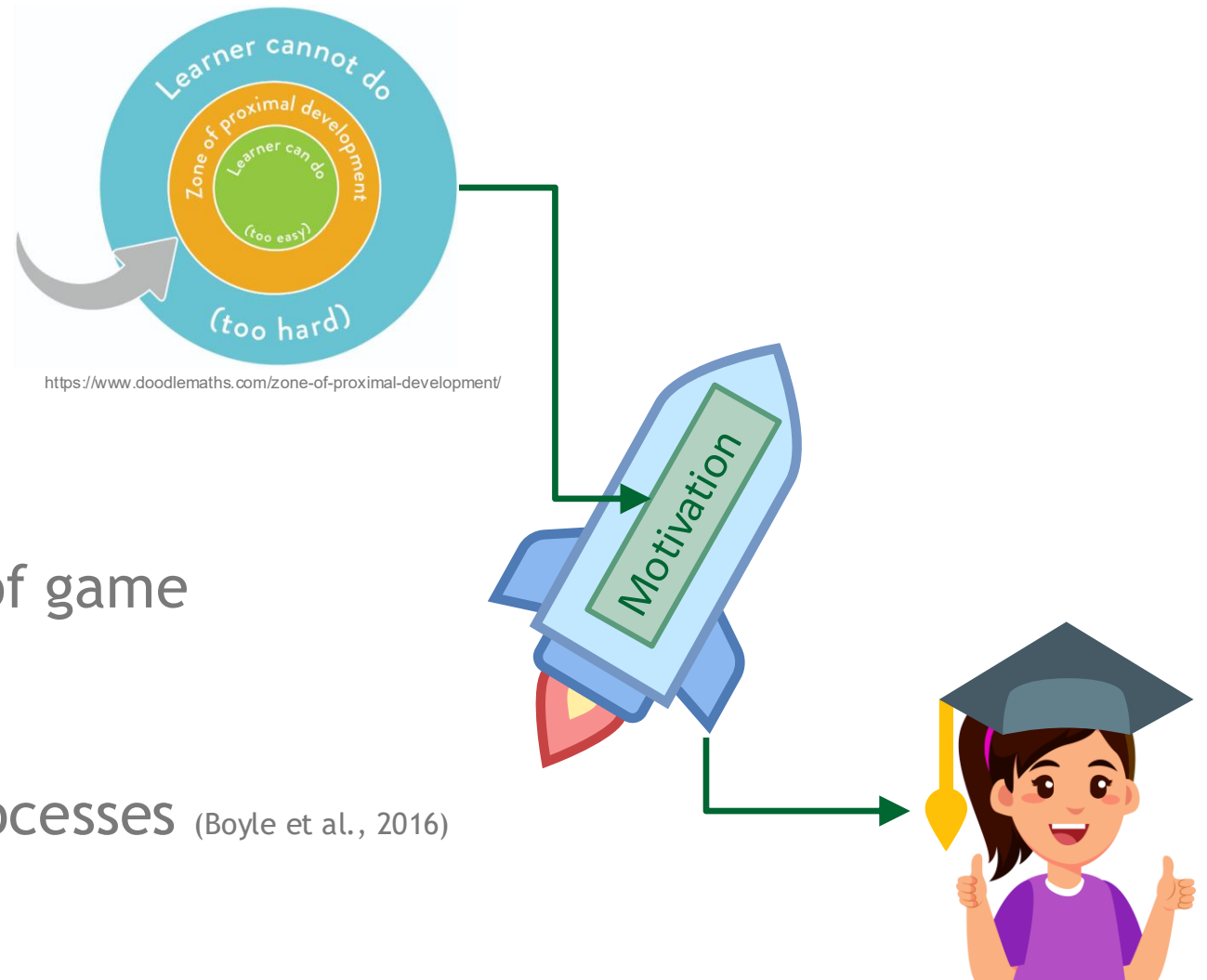
Heiko Holz*, Katharina Wendebourg*, Ines Pieronczyk, Stephen Bodnar, Detmar Meurers, Cora Parrisius

Design and User Preferences of Pedagogical Agents for an Intelligent Tutoring System for EFL

Opportunities of Digital (Game-Based or Gamified) Learning

- Learner modeling allows to adapt to individual learning curves
 - Flow (Csikszentmihalyi, 1975)
 - Zone of proximal development (Vygotsky, 1978)
- Boosting motivation with the use of game elements (Deterding et al., 2011)

→ Leading to successful learning processes (Boyle et al., 2016)



Grammar - Simple Past 59004 regular/irregular verbs mixed 4

Write down the correct form of the simple past for the following verbs.

My mother called ✓ (call) my sister 5 times this afternoon.

I accepted ✓ (accept) the job offer from Ireland.

Messi kicked ✓ (kick) the ball. It was a goal.

My friend puted ✗ (put) the cheese into the fridge.

I _____ (keep) my diary

This book _____ (become)

They _____ (return) to

Elon Musk _____ (send)

Feedback für "puted"

We do not add -ed to an irregular form of the simple past or an irregular past participle.

Ist dieses Feedback hilfreich?



keine Angabe

THE INTELLIGENT TUTORING SYSTEM "FEEDBOOK"

FOR SEVENTH-GRADE ENGLISH AS A FOREIGN LANGUAGE LEARNERS

Context and Setting: The FeedBook

- Intelligent Language Tutoring System (ILTS)
- English foreign language (EFL) learning in formal education
- Targeting 7th grade classrooms in German schools
- Provides feedback during individual practice phases



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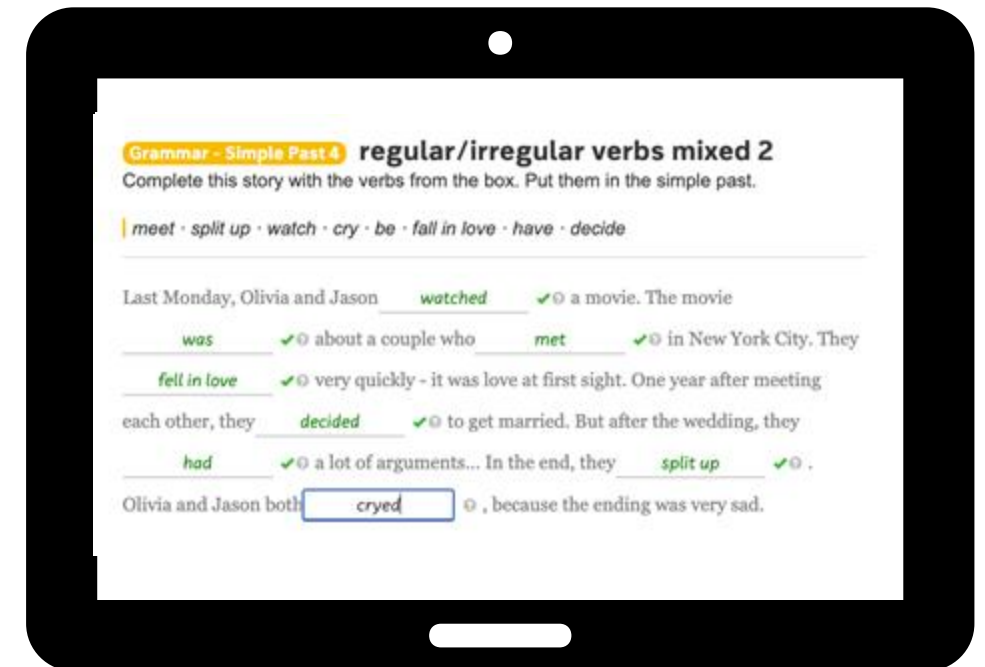
Grammar - Simple Past 4 regular/irregular verbs mixed 2
Complete this story with the verbs from the box. Put them in the simple past.

meet · split up · watch · cry · be · fall in love · have · decide

Last Monday, Olivia and Jason watched  a movie. The movie  about a couple who  in New York City. They  very quickly - it was love at first sight. One year after meeting each other, they  to get married. But after the wedding, they  a lot of arguments... In the end, they  . Olivia and Jason both  , because the ending was very sad.

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Context and Setting: The FeedBook

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Feedback für "cried"

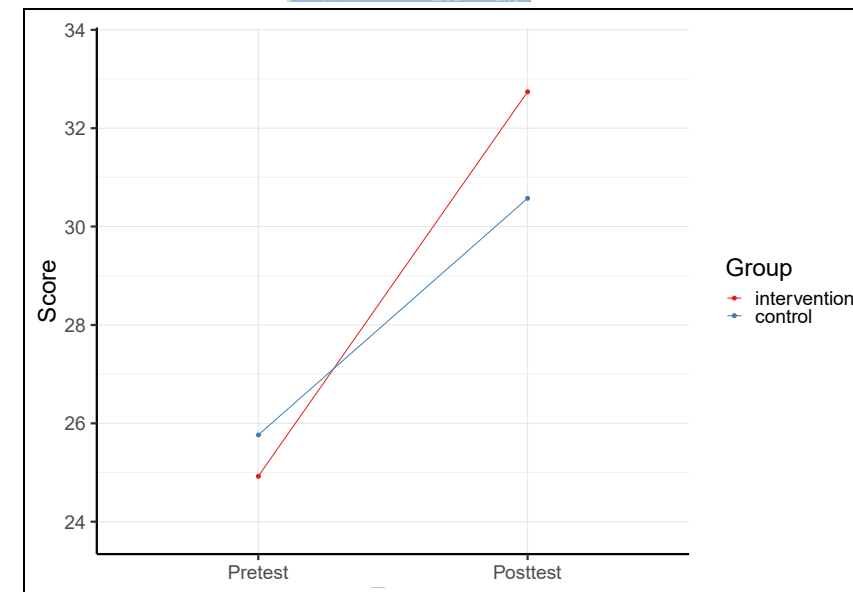
When an infinitive ends in 'consonant + y', we change the 'y' to 'i' in the simple past.

Ist dieses Feedback hilfreich?



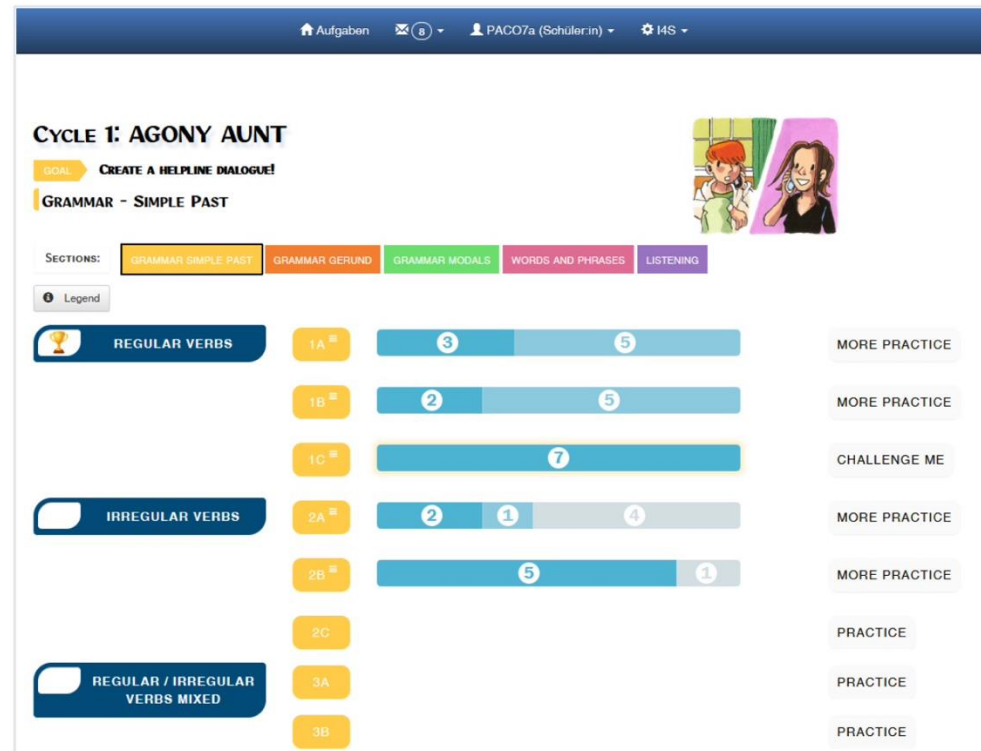
Context and Setting: The FeedBook

- Intelligent Language Tutoring System (ILTS)
- English foreign language (EFL) learning in formal education
- Targeting 7th grade classrooms in German schools
- Provides feedback during individual practice phases
- Scaffolding feedback in intelligent computer assisted language learning systems can be effective (Meurers et al., 2019)



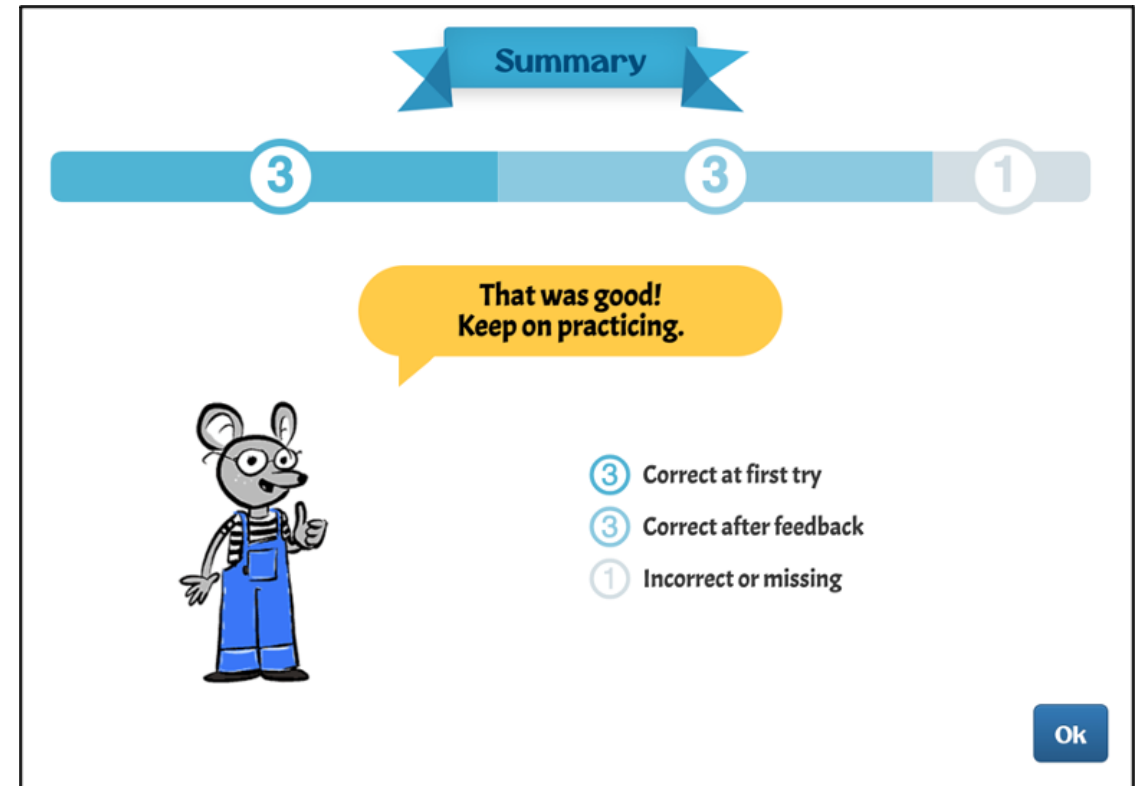
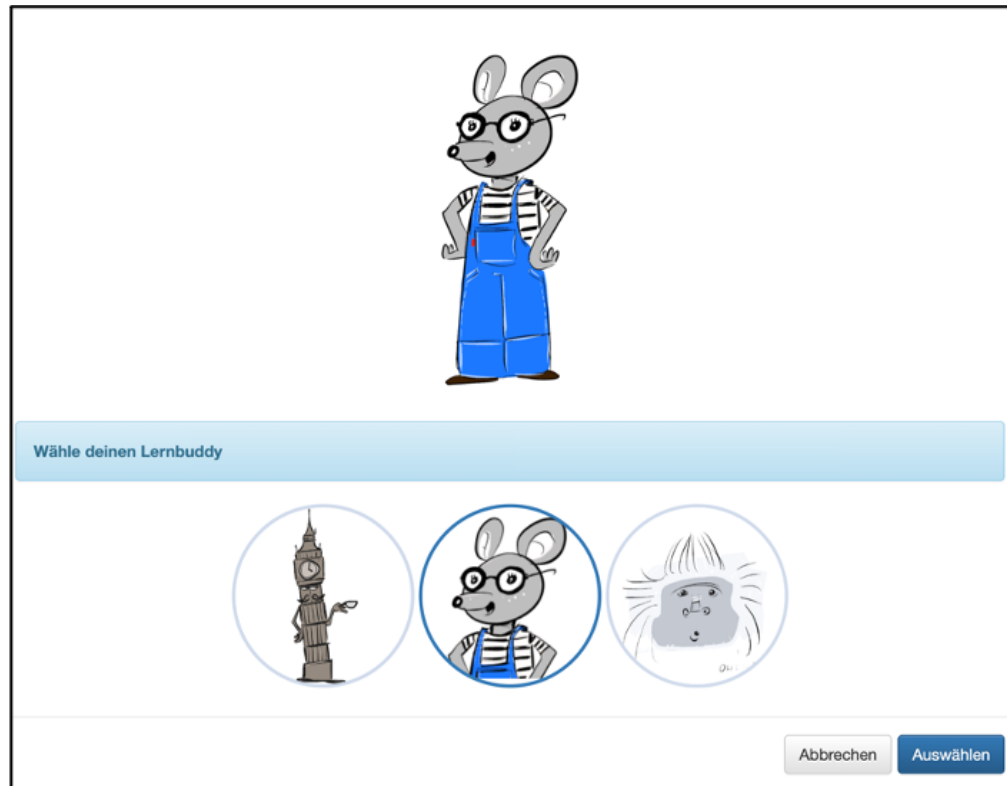
N = 205 students from 10 classes
(Image Source: Meurers et al., 2019)

Gamification 1: Learner Dashboard to Visualize Students' Performance



| Section | Item | Score | Max Score | Action |
|---------------------------------|------|-------|-----------|---------------|
| REGULAR VERBS | 1A | 3 | 5 | MORE PRACTICE |
| | 1B | 2 | 5 | MORE PRACTICE |
| | 1C | 7 | 7 | CHALLENGE ME |
| IRREGULAR VERBS | 2A | 2 | 4 | MORE PRACTICE |
| | 2B | 5 | 5 | MORE PRACTICE |
| | 2C | | | PRACTICE |
| REGULAR / IRREGULAR VERBS MIXED | 3A | | | PRACTICE |
| | 3B | | | PRACTICE |

Gamification 2: Pedagogical Agent to Motivate Students



♥ Lernbuddy (BITTE NACH UNTEN SCROLLEN)



Wähle deinen Lernbuddy

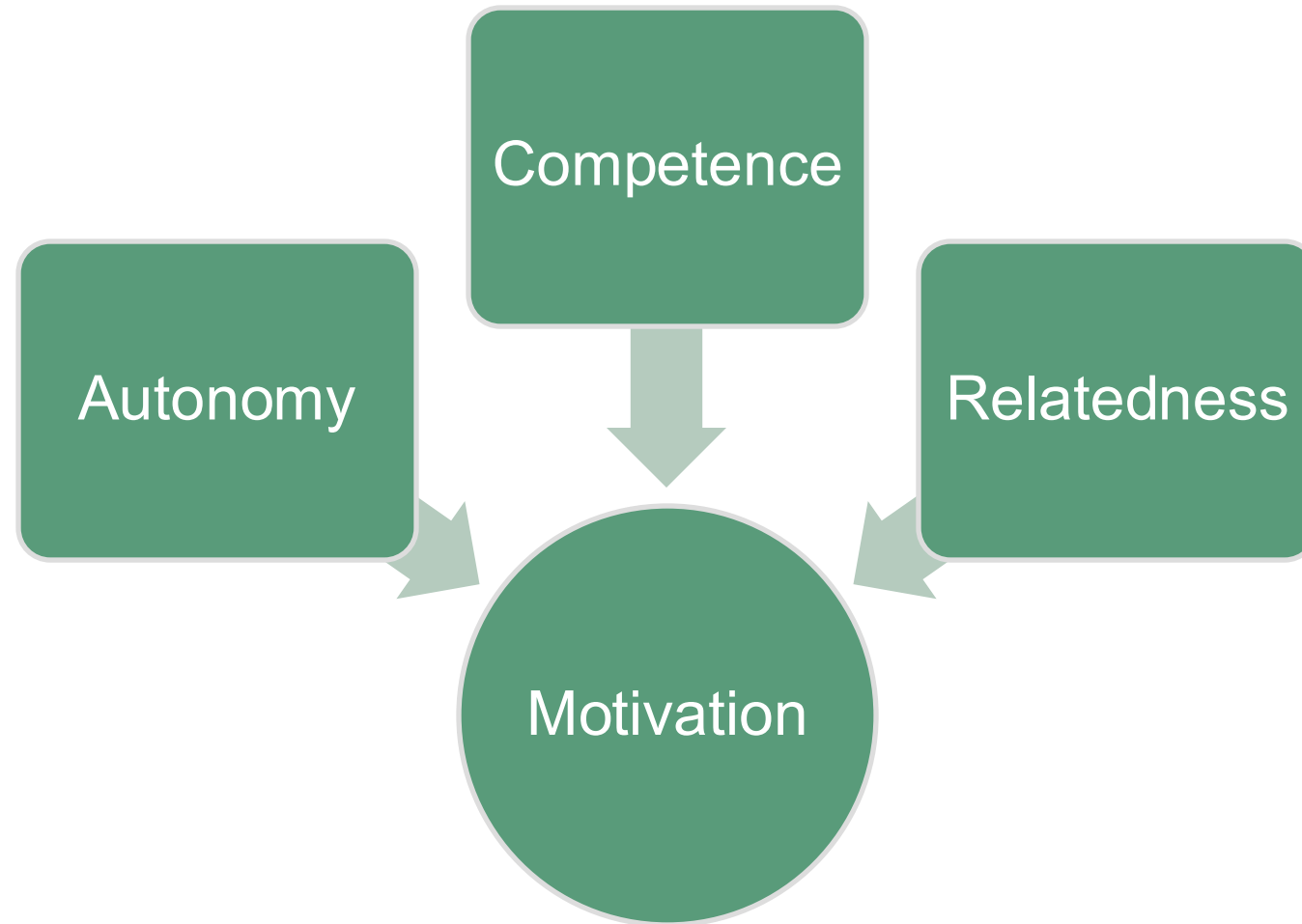


PEDAGOGICAL AGENTS

SOCIAL INTERACTION AND RELATEDNESS

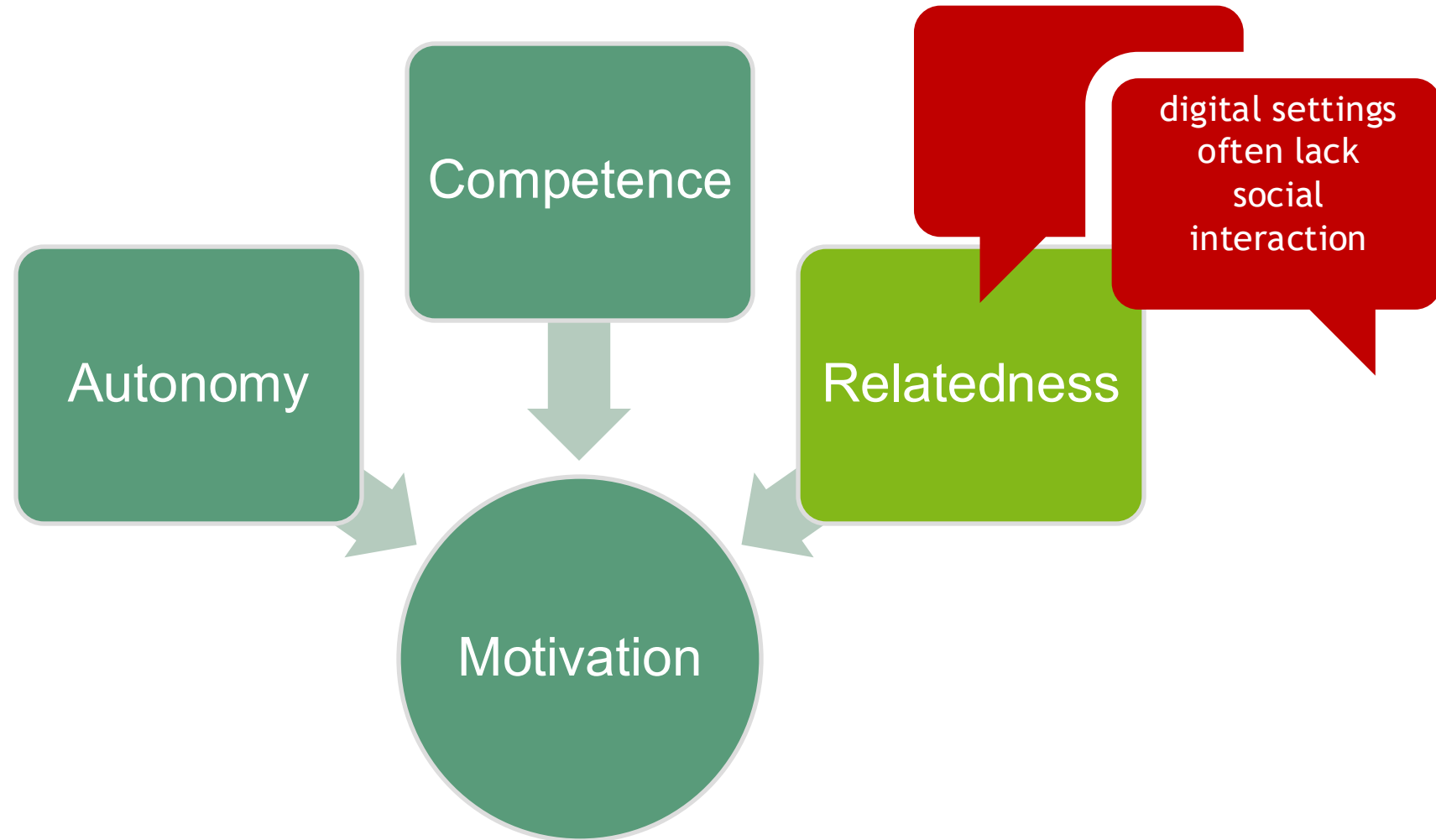
Pedagogical Agents: Self-Determination Theory

(Ryan & Deci, 2000)



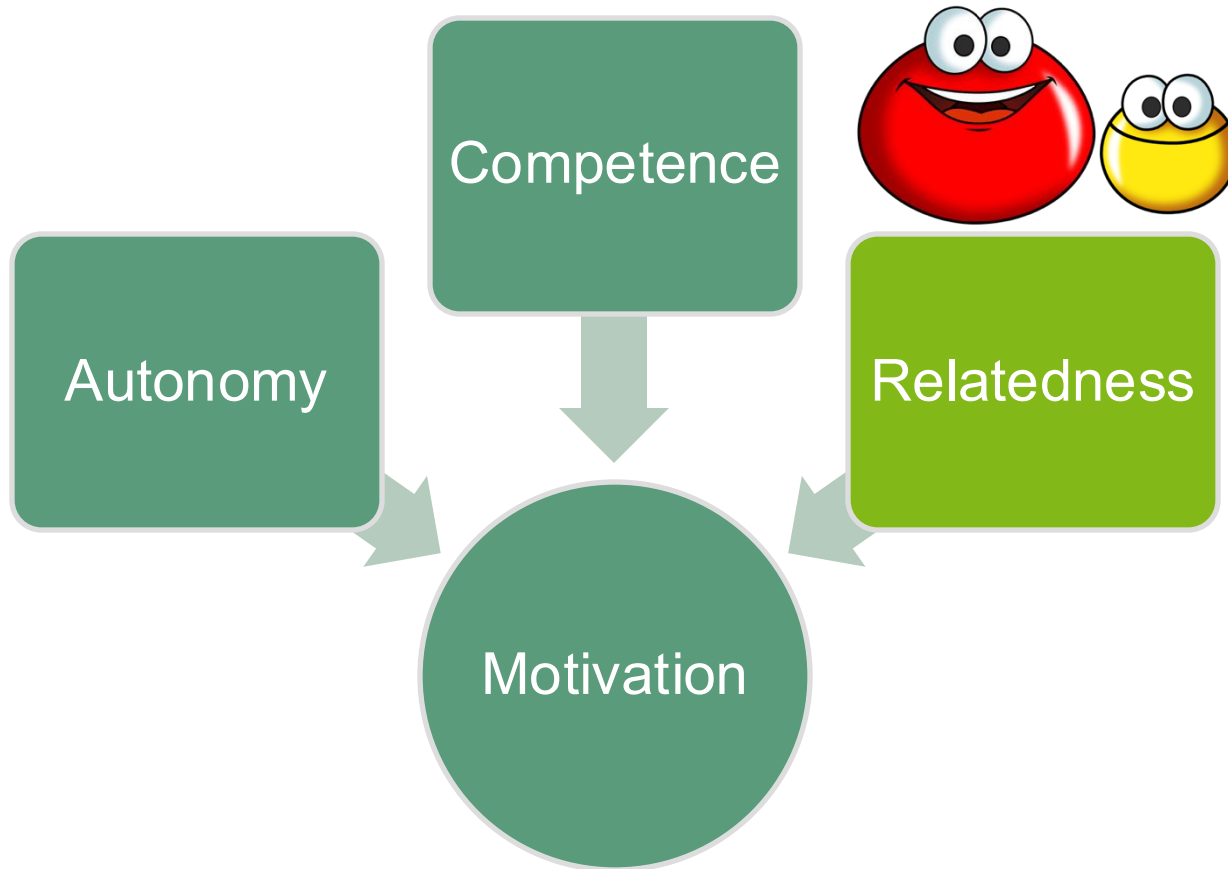
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Pedagogical Agents: Self-Determination Theory

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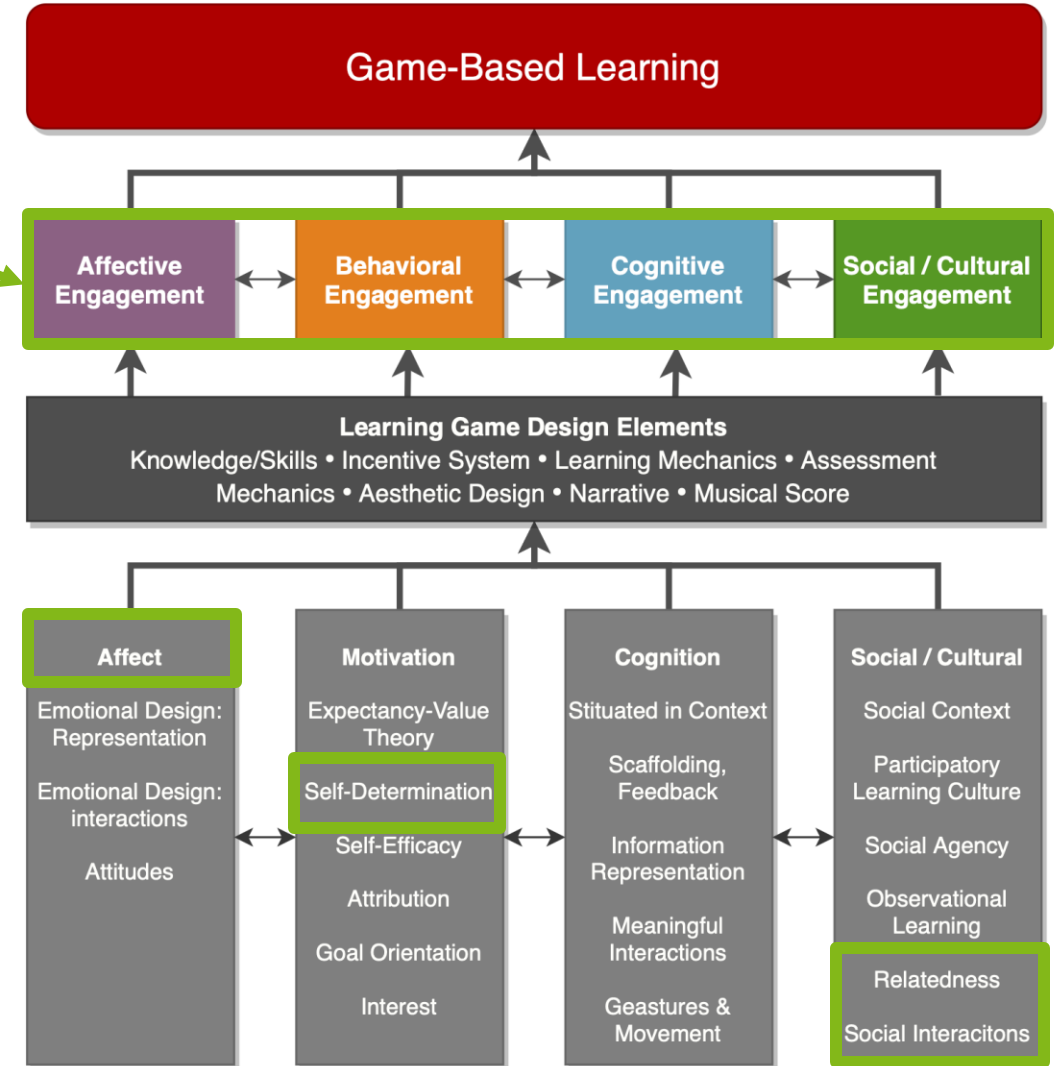
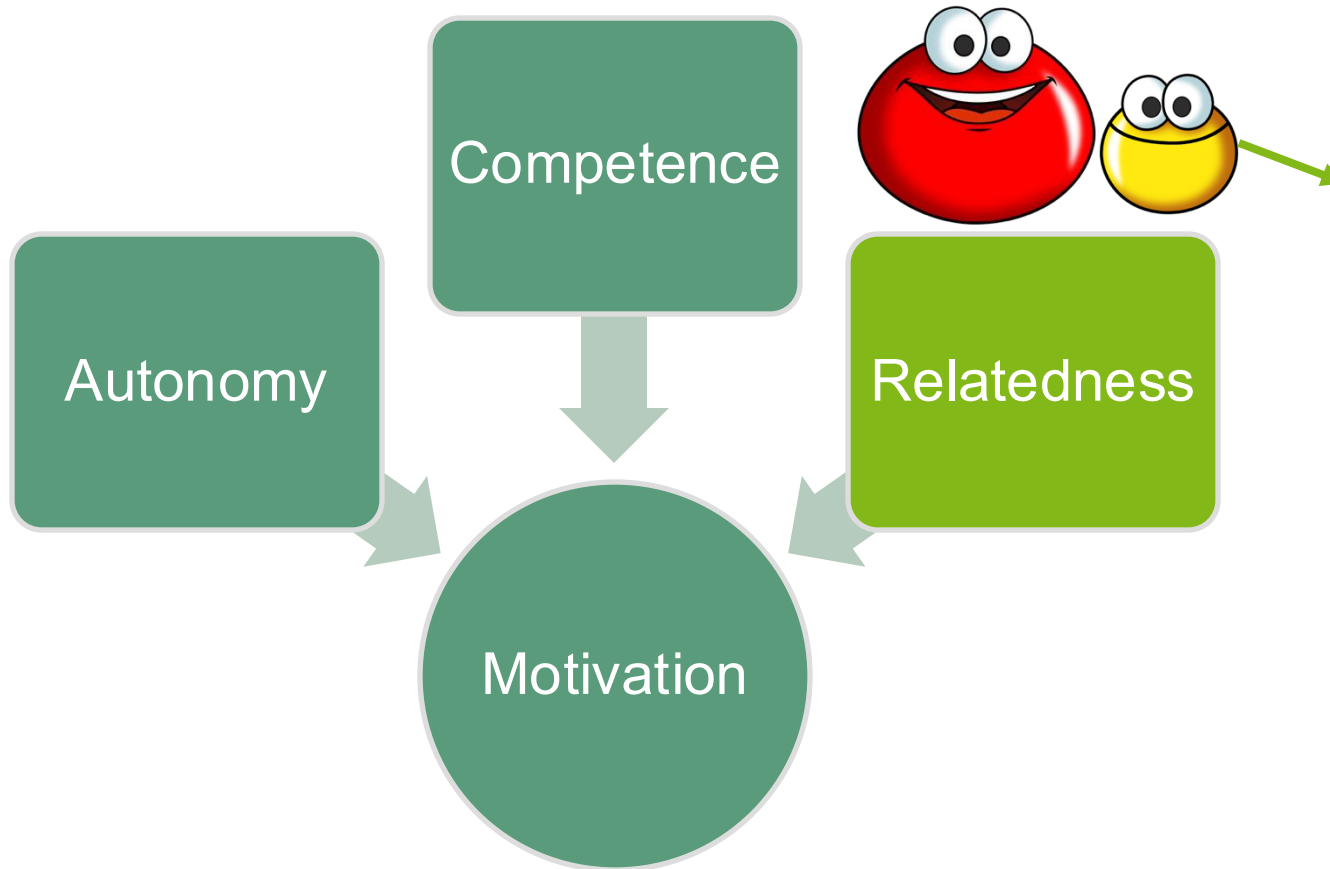


Pedagogical Agents

address lack of social interaction and may

- induce a feeling of being connected to others (Przybylski et al., 2010).
- act as tutors providing personal, often affective and contextualized feedback supporting and co-regulating learners' emotions (Mohanty, 2016).
- support positive emotions and intrinsic motivation in learners (Liew, 2017).
- lead to higher engagement in ILTS; students may even consider them as friends (Holz et al., 2018, 2023)
- increase learners' self-efficacy and self-regulated learning using affirmative communication (Dever, 2013; Sikström, 2024).

Pedagogical Agents: Self-Determination Theory (Ryan & Deci, 2000)



Research Questions


- **RQ1:** How can we design pedagogical agents that are appealing and meaningful for seventh graders? Which character is most appealing to seventh graders?
- **RQ2:** What characteristics do seventh graders attribute to their preferred pedagogical agent? What are the students' reasons for choosing a character?

DESIGN RATIONALES OF THE PEDAGOGICAL AGENTS

Summary

5 3

Bravo!
You figured it out.

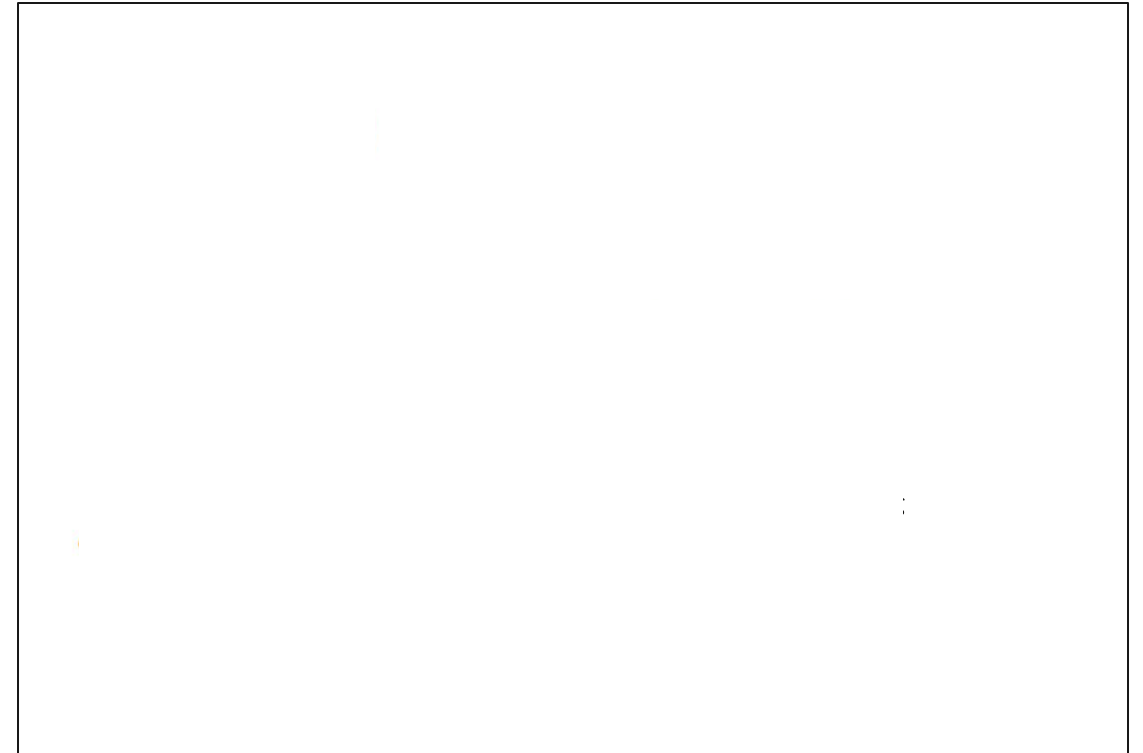


- 5 Correct at first try
- 3 Correct after feedback
- 0 Incorrect or missing

Ok

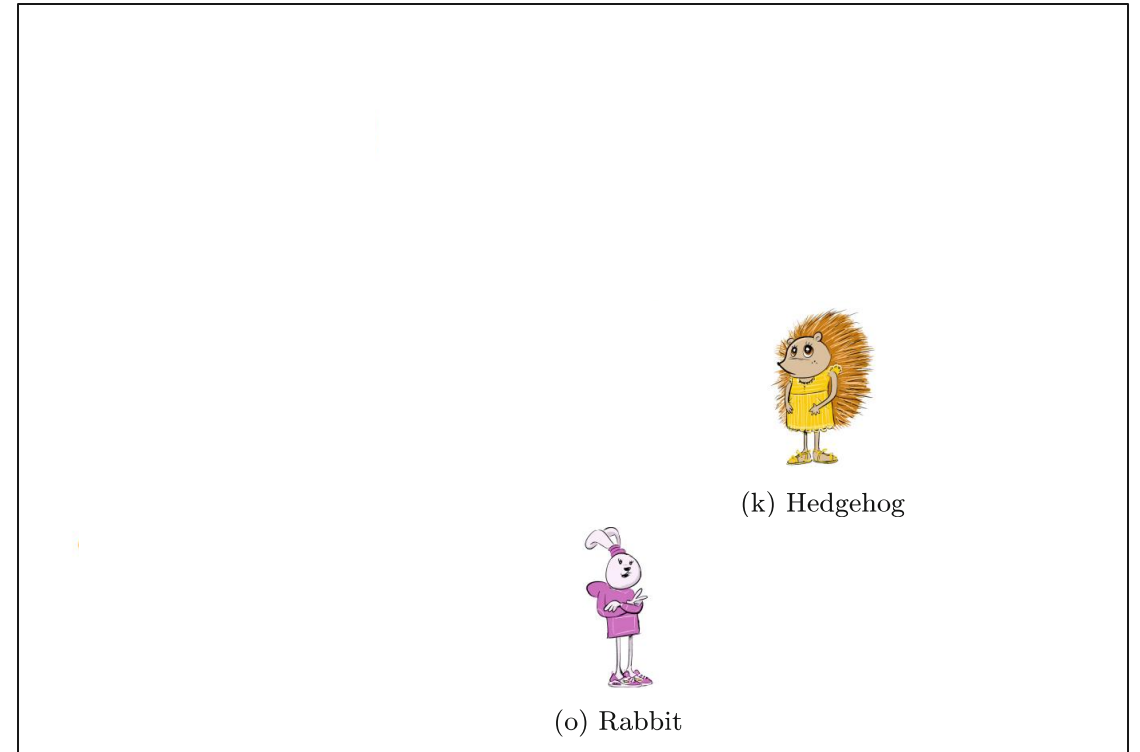
Design Rationales of the Pedagogical Agents

- provide students with several characters with varying features



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 - female, e.g., Hedgehog, Rabbit



Design Rationales of the Pedagogical Agents

- provide students with several characters with varying features
 - female, e.g., Hedgehog, Rabbit
 - male, e.g., Hog, Bear



(b) Bear



(d) Hog



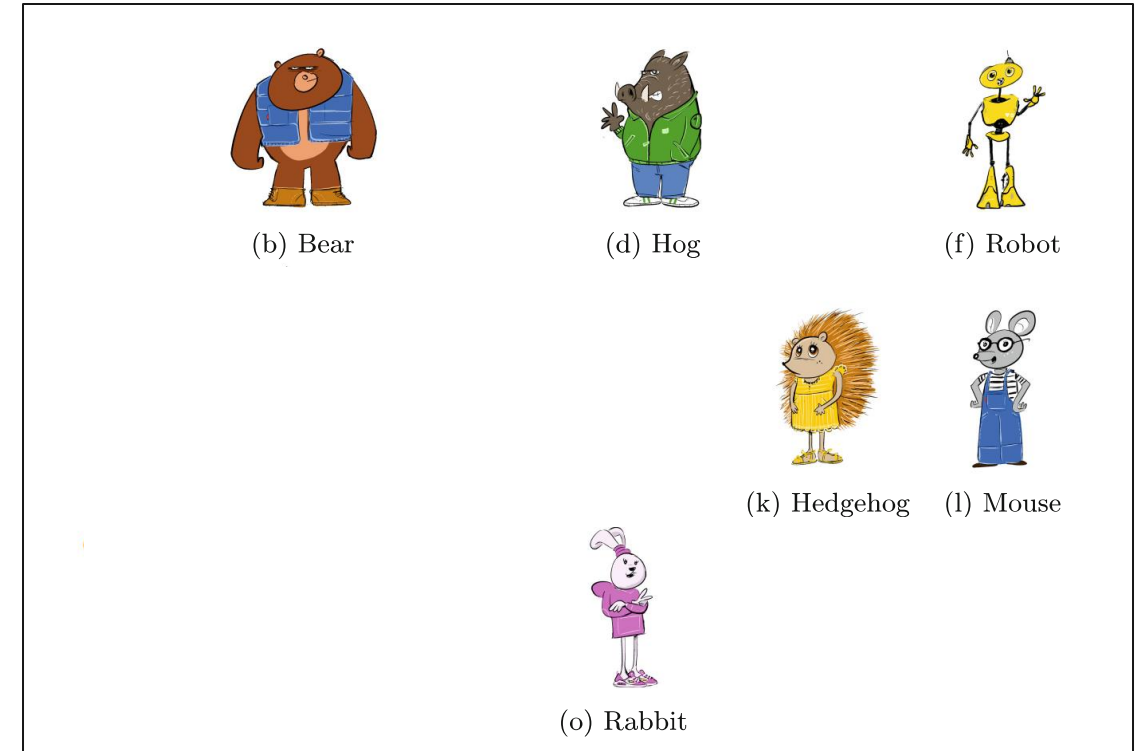
(k) Hedgehog



(o) Rabbit

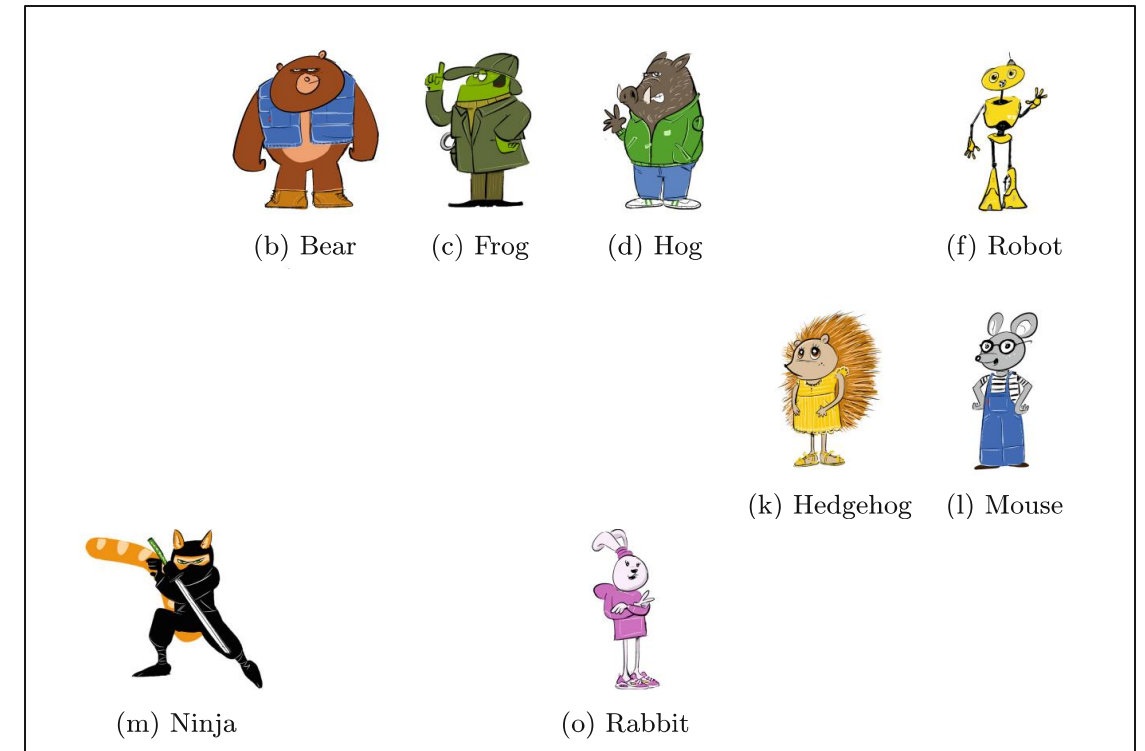
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 - gender neutral, e.g., Mouse, Robot



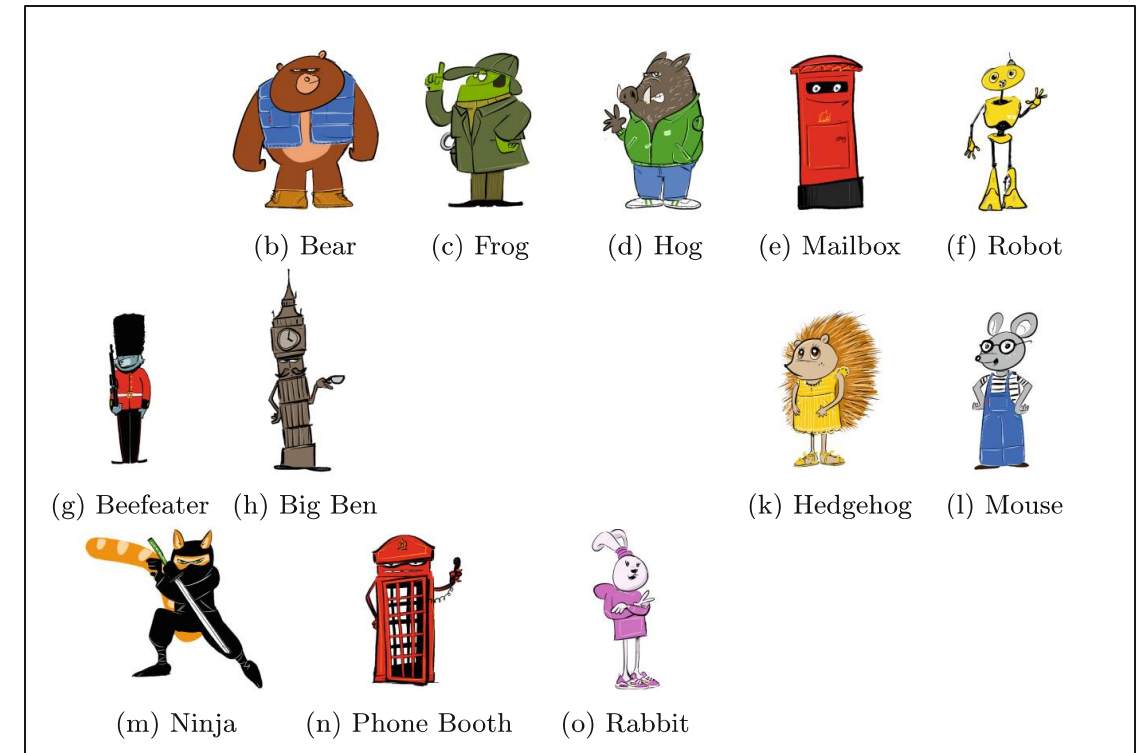
Design Rationales of the Pedagogical Agents

- provide students with several characters with varying features
 - female, e.g., Hedgehog, Rabbit
 - male, e.g., Hog, Bear
 - gender neutral, e.g., Mouse, Robot
- implying certain personality characteristics, e.g.,
 - Ninja Squirrel is brave
 - Detective Frog is smart



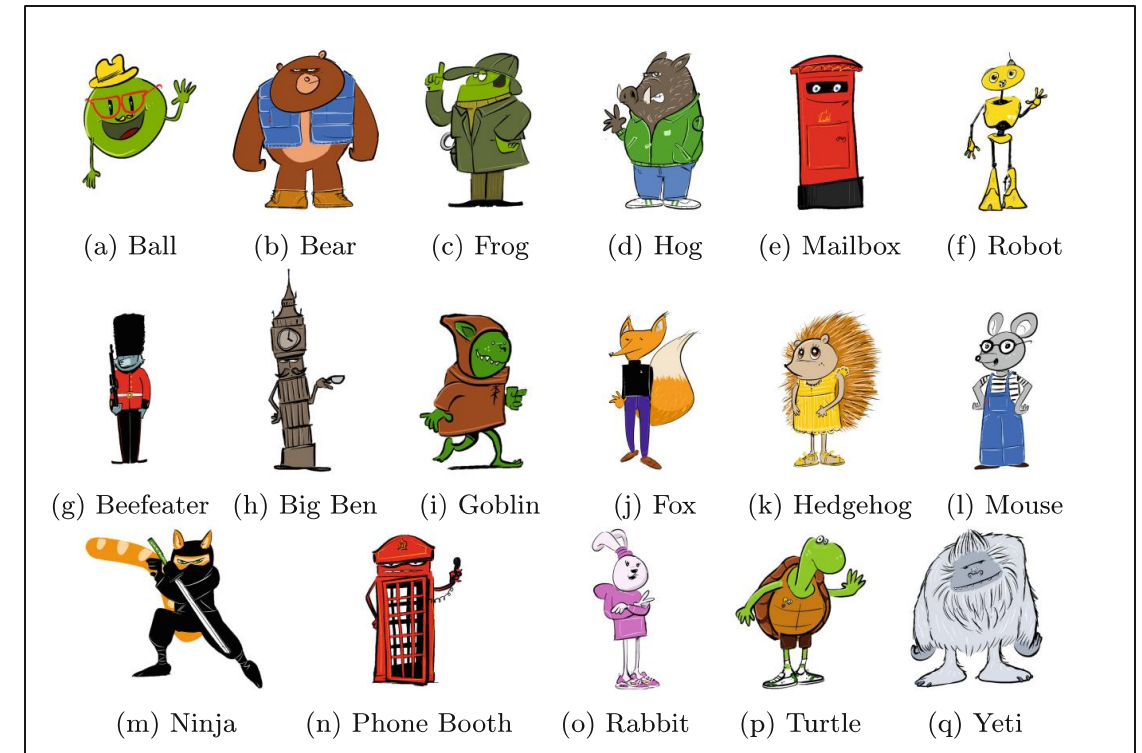
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- some related to British culture to give a motivational anchor
 - Mailbox, Beefeater, Big Ben, Phone Booth



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♥ Lernbuddy (BITTE NACH UNTEN SCROLLEN)



Wähle deinen Lernbuddy

FIRST USER STUDY

First User Study

- **Goal:** select 10 agents for detailed analysis in second user study
- **Participants:** 55 seventh-graders from academic-track school



(a) Ball



(b) Bear



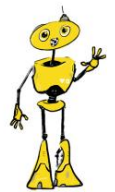
(c) Frog



(d) Hog



(e) Mailbox



(f) Robot



(g) Beefeater



(h) Big Ben



(i) Goblin



(j) Fox



(k) Hedgehog



(l) Mouse



(m) Ninja



(n) Phone Booth



(o) Rabbit



(p) Turtle

Fig. 1. Pedagogical agents included in the first user study: (a) Ball to (p) Turtle.

First User Study

- **Goal:** select 10 agents for detailed analysis in second user study
- **Participants:** 55 seventh-graders from academic-track school
- **Procedure:** students were asked to
 1. **rate** each agent individually (*“How do you like the character as a learning buddy for a digital English workbook?”*), and



Wie findest du die Figur als Begleiter in einem digitalen Englischübungsheft?

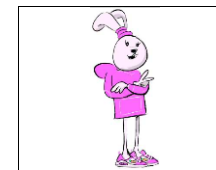
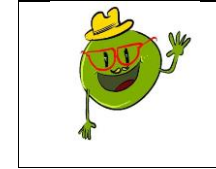
PA05

Ich finde diese Figur...

First User Study

Welche Figuren gefallen dir am besten?

Bringe die Figuren in deiner persönliche Rangordnung! Welche Figur gefällt dir **am besten**? Setze diese auf Position 1 und die Figur, die dir **am wenigsten** gefällt, auf den letzten Platz. Nutze einfach die Maus, um die Bilder zu verschieben.

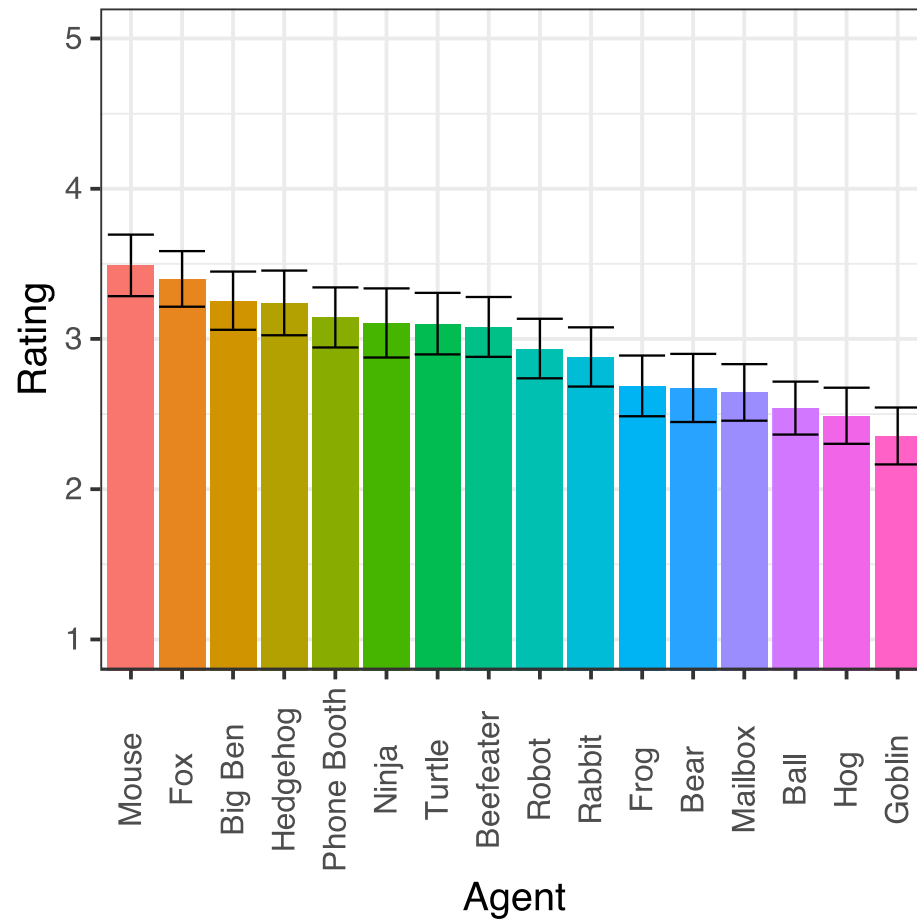


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| 16 |

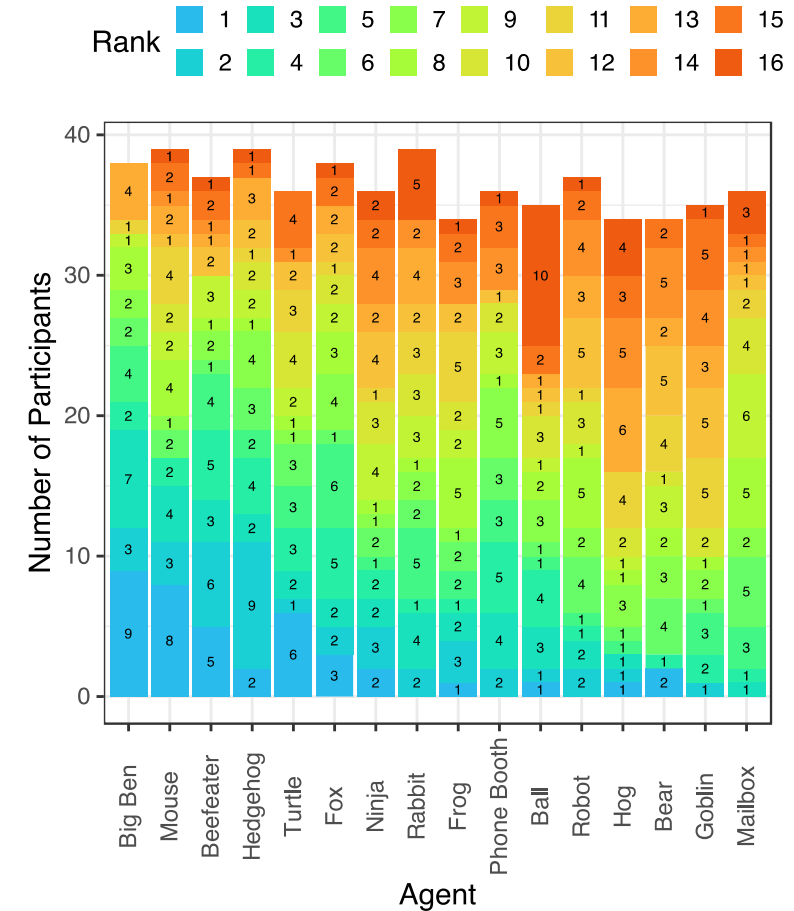
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- **Procedure:** students were asked to
 1. **rate** each agent individually (*“How do you like the character as a learning buddy for a digital English workbook?”*), and
 2. **rank** the agents (*“Which character do you like best? Rank the characters in your personal order!”*).

First User Study: Results

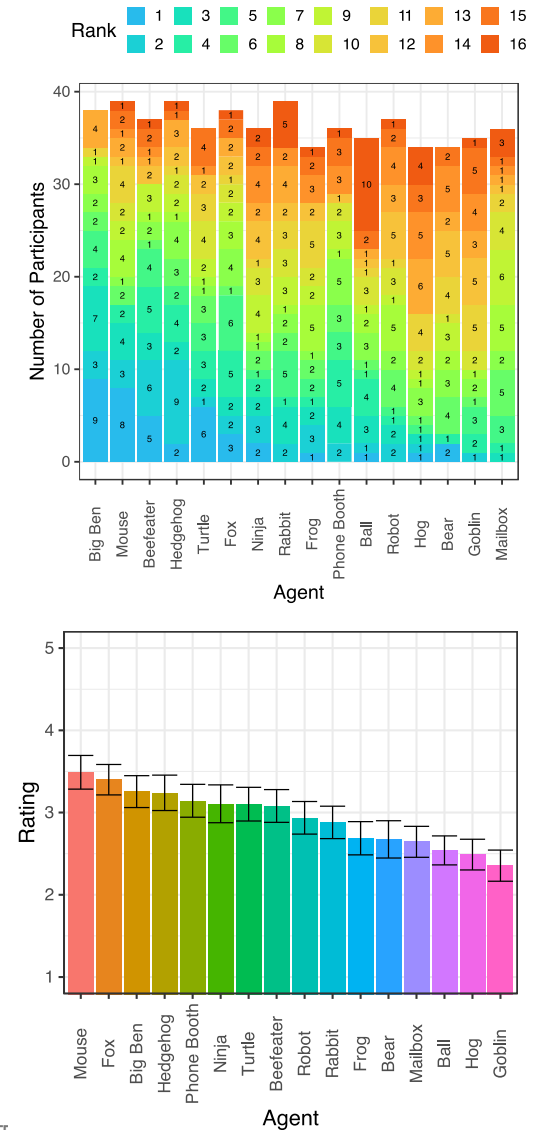
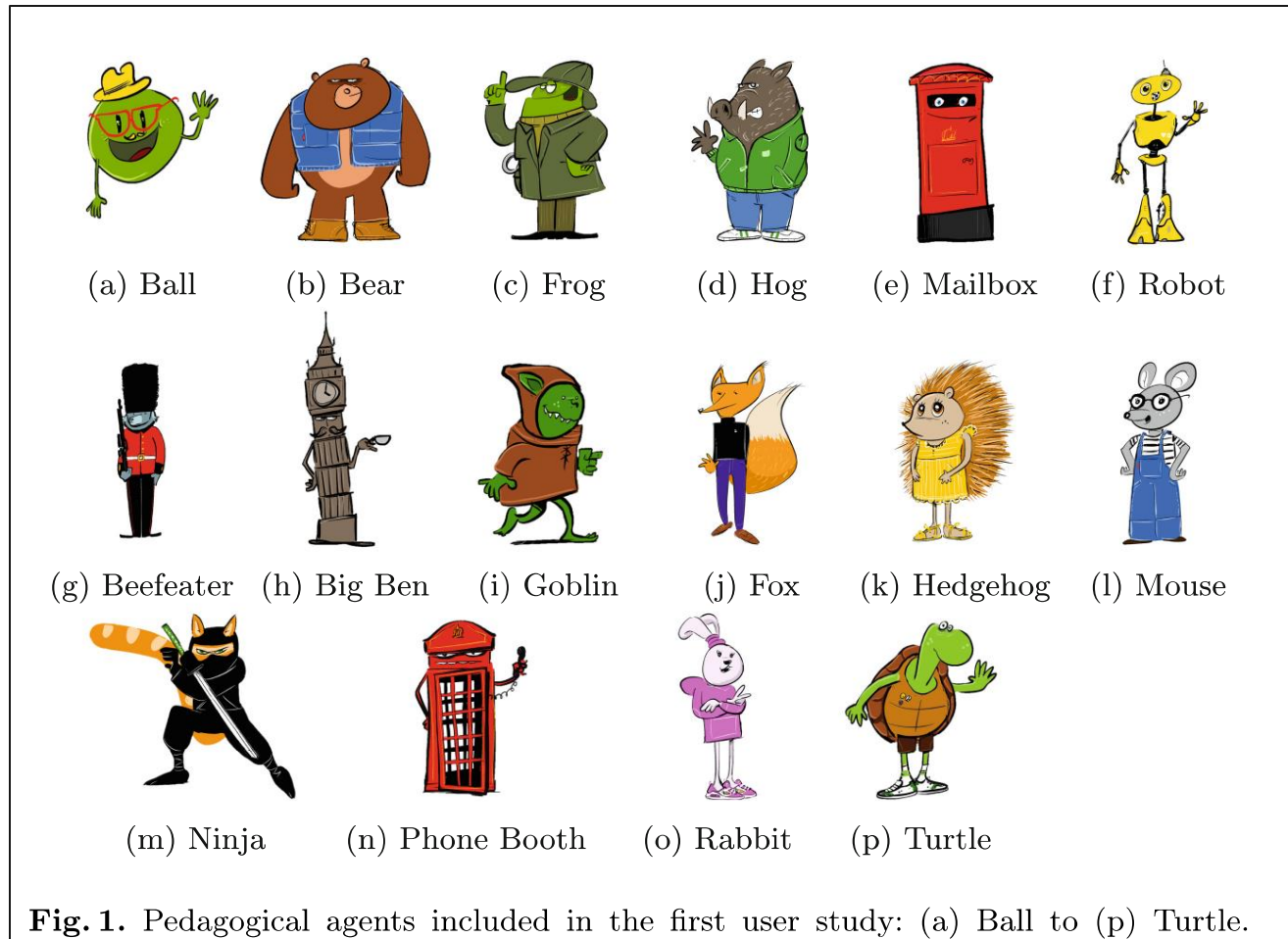
Rating



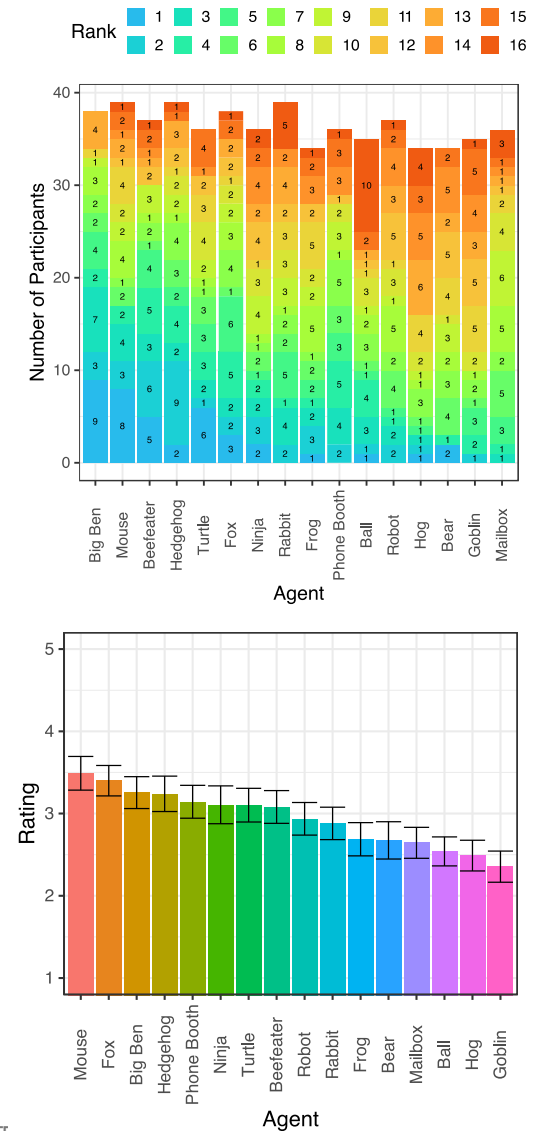
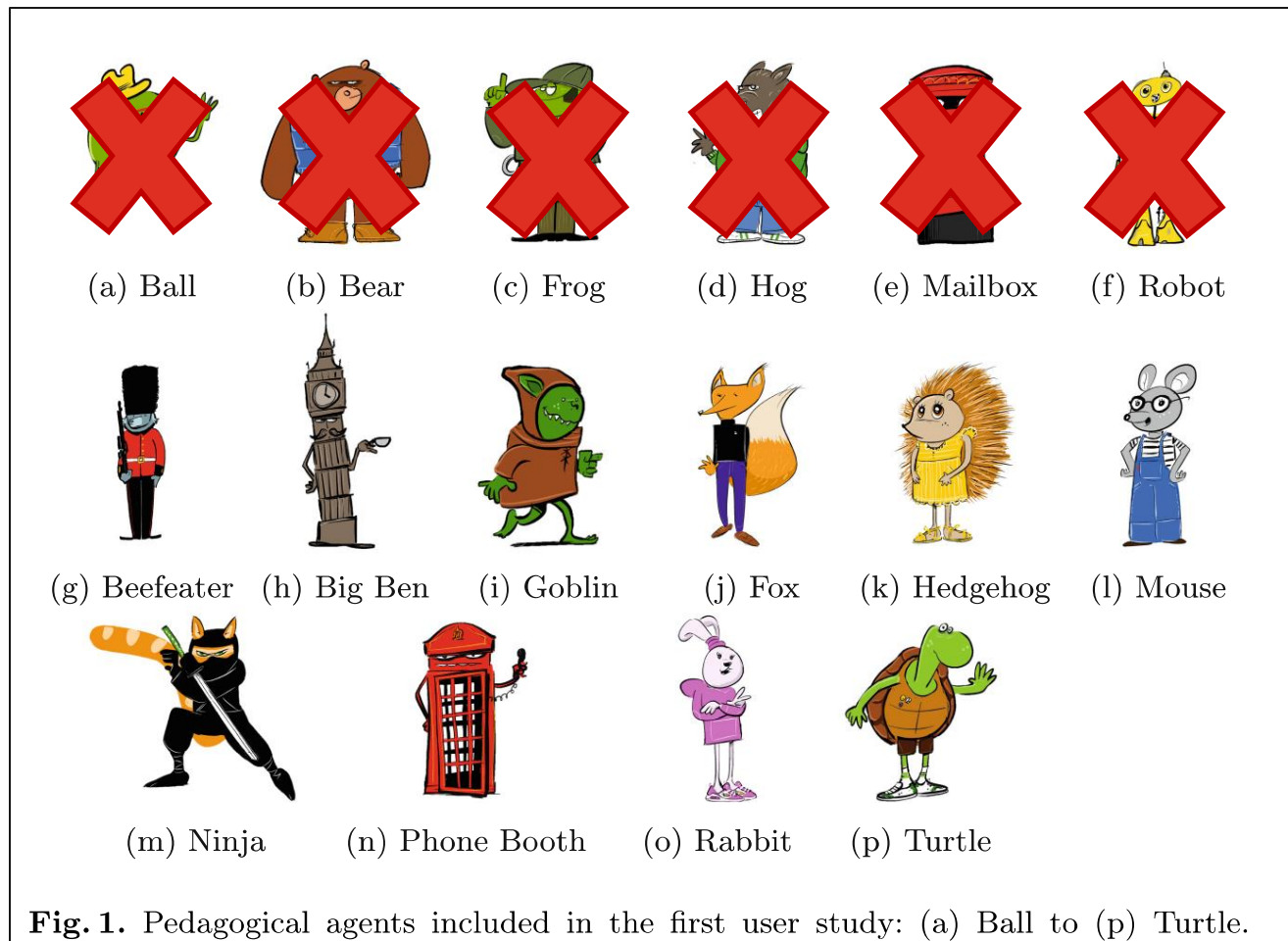
Ranking



First User Study: Results



First User Study: Results



♥️ Lernbuddy (BITTE NACH UNTEN SCROLLEN)

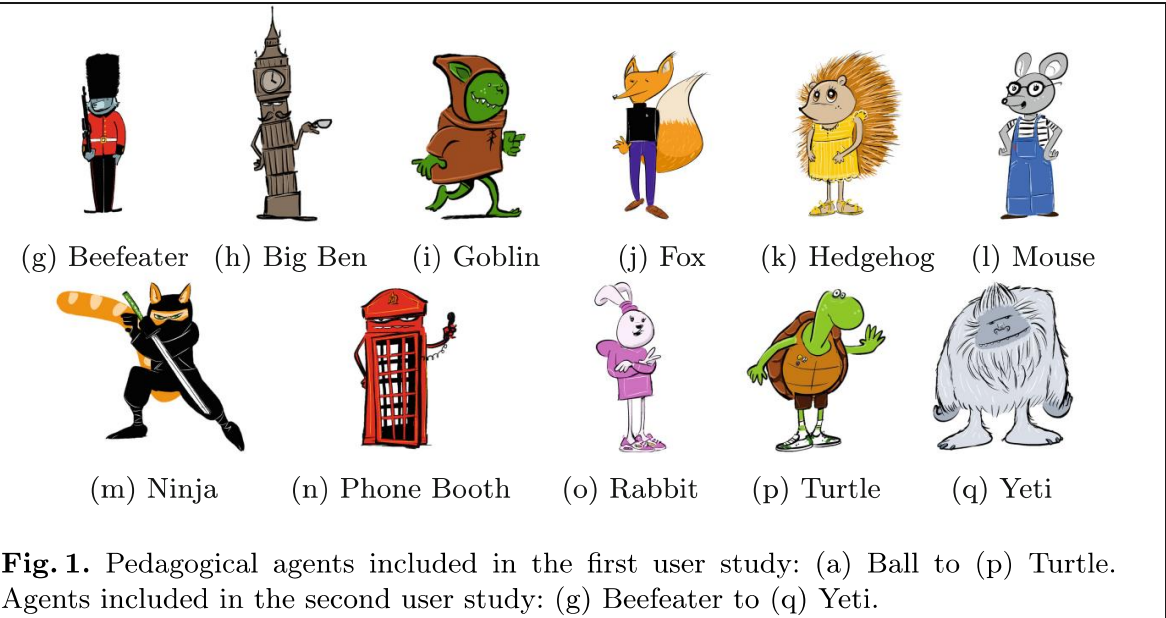


Wähle deinen Lernbuddy

SECOND USER STUDY

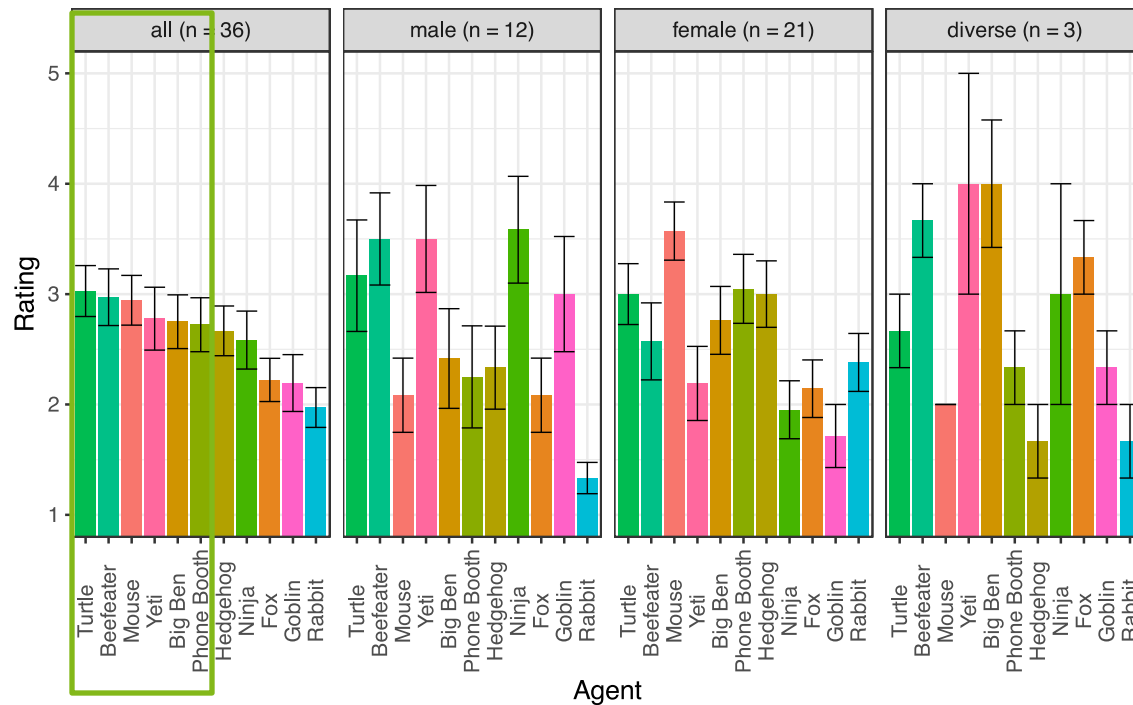
Second User Study

- **Goal:** select three agents for implementation in the FeedBook
- **Participants:** 36 seventh-grade students
 - 12 male, 21 female, 3 diverse
 - aged $M = 13.11$ ($SD = 0.89$)
- **Procedure:** Students were asked to
 1. rate each agent individually,
 2. rank the agents,
 3. explain why they chose their favorite (open question), and
 4. select three reasons from a set of attributes for the agent they have ranked best.

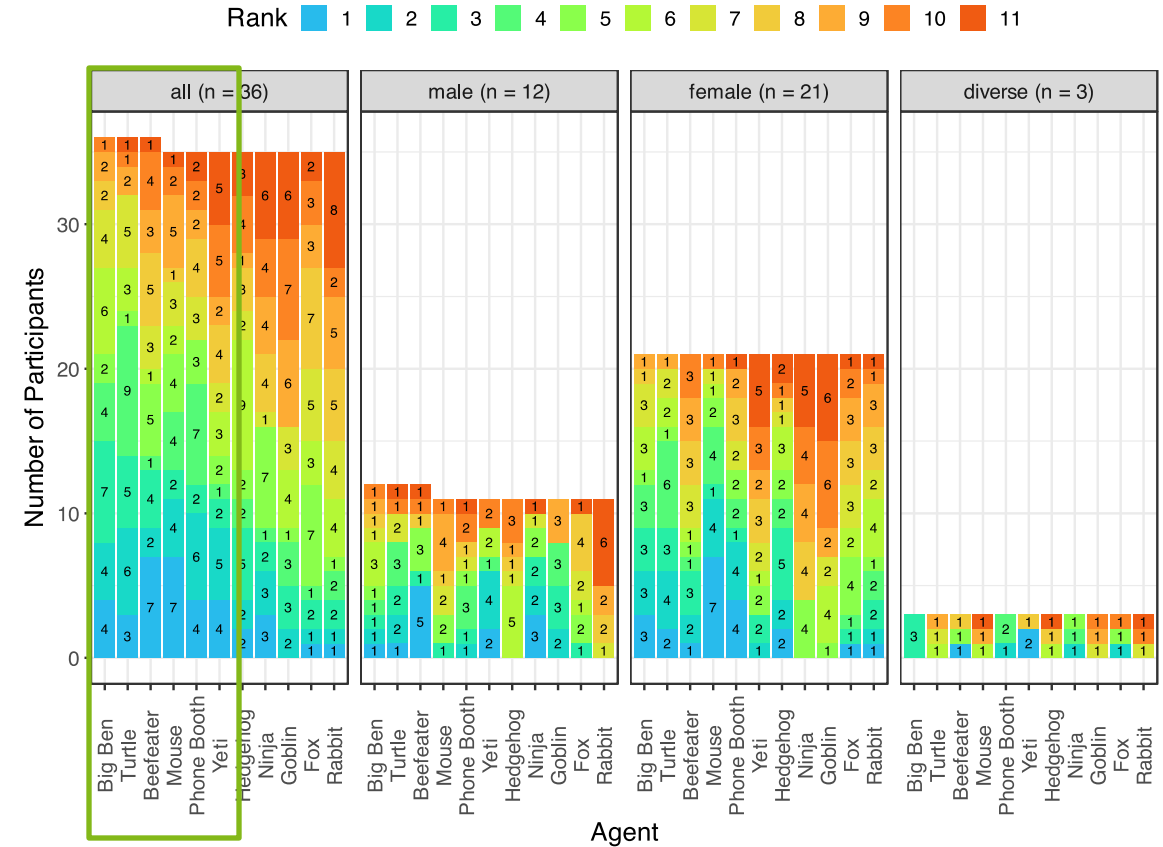


Second User Study: Results

Rating



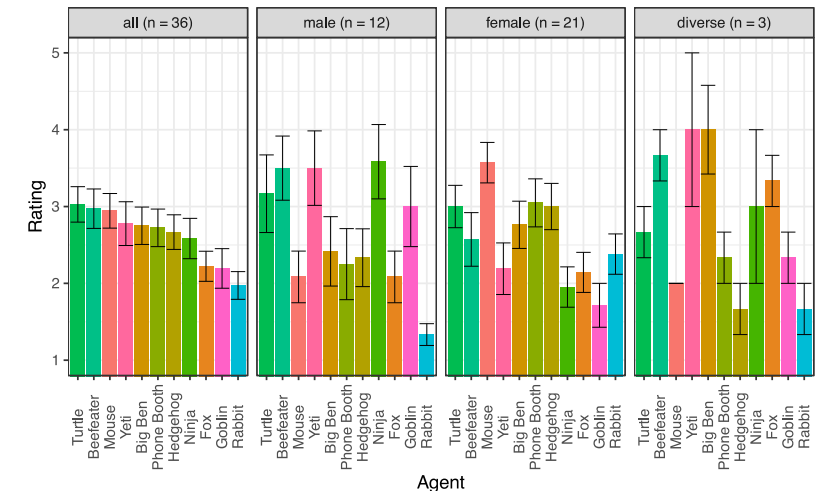
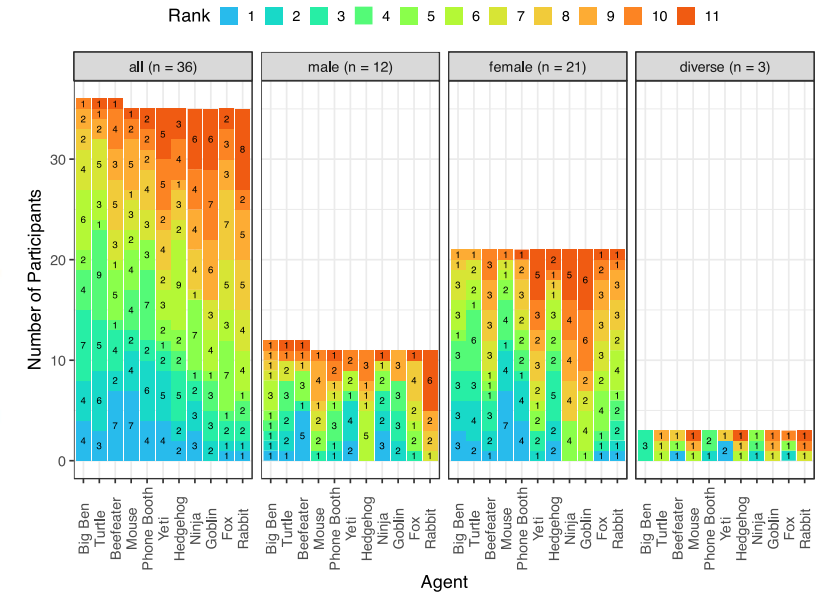
Ranking



Second User Study: Results

Table 1: Students' reasons for picking their favorite agent in the second user study, summarized across the reasons' ranks.

| | Total | Big Ben | Beef-Turtle eater | Phone Mouse Booth Yeti | Hedgehog | Ninja | Fox | Rabbit |
|------------------------------------|-------|---------|-------------------|------------------------|----------|-------|-----|--------|
| looks likeable | 17 | 1 | 1 | 2 | 4 | 3 | 2 | 1 |
| I like the animal/character | 14 | 1 | 2 | 1 | 1 | 3 | 1 | 2 |
| looks cute | 13 | 1 | 2 | - | 7 | 1 | - | - |
| best drawn | 13 | 1 | - | 2 | 3 | - | 4 | - |
| speaks English well | 12 | 3 | - | 4 | 1 | 3 | - | - |
| looks funny | 12 | 3 | 2 | - | 1 | 2 | 2 | - |
| looks like he/she/they knows a lot | 11 | 4 | - | 2 | 3 | - | - | - |
| least childlike | 10 | 1 | - | 3 | 1 | 2 | 1 | - |
| looks smart | 9 | 1 | 1 | 2 | 3 | - | - | - |
| can teach me something | 9 | 1 | 1 | 2 | 1 | 1 | - | 1 |
| can give good feedback | 8 | 2 | - | 1 | 1 | 1 | - | - |
| looks supportive | 7 | 1 | 1 | 2 | 1 | 1 | - | - |
| looks athletic | 6 | 1 | - | - | - | 2 | - | - |
| looks cunning | 4 | 1 | - | - | 1 | - | 1 | - |
| I can identify with her/him/them | 3 | 2 | - | - | - | - | - | - |

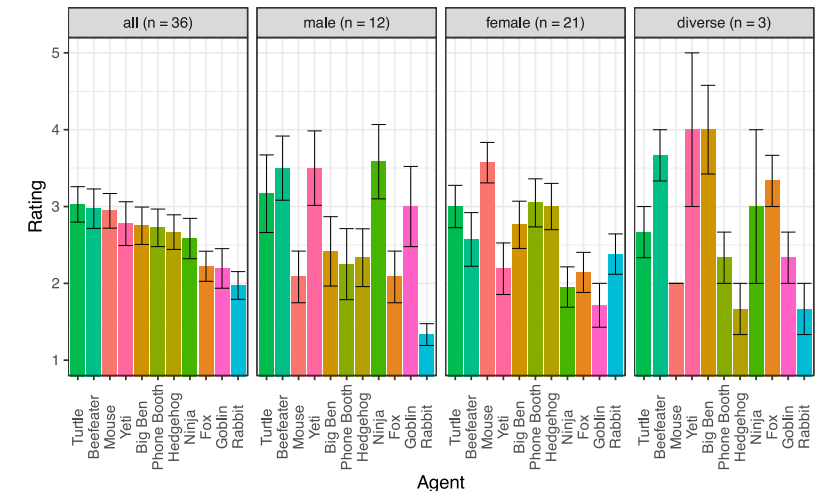
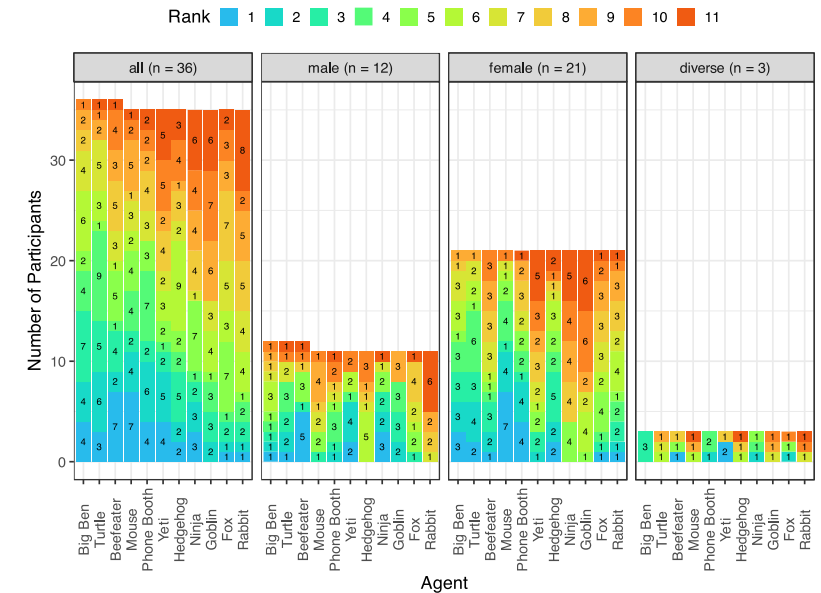


Second User Study: Results

- Students argued most for their favourite that he/she/they looks likable, cute, best drawn, funny, least childlike, and that they liked the animal/character
- It was also important that the characters can teach them something and give good feedback
- UK-themed characters were most often attributed to speak English well and to know a lot, in line with the expert hypothesis (Liew et al, 2013)

Table 1: Students' reasons for picking their favorite agent in the second user study, summarized across the reasons' ranks.

| | Total | Big Ben | Turtle | Beef-eater | Mouse | Phone Booth | Yeti | Hedgehog | Ninja | Fox | Rabbit |
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| can teach me something | 9 | 1 | 1 | 2 | 1 | 1 | - | 1 | 1 | 1 | - |
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Second User Study: Results

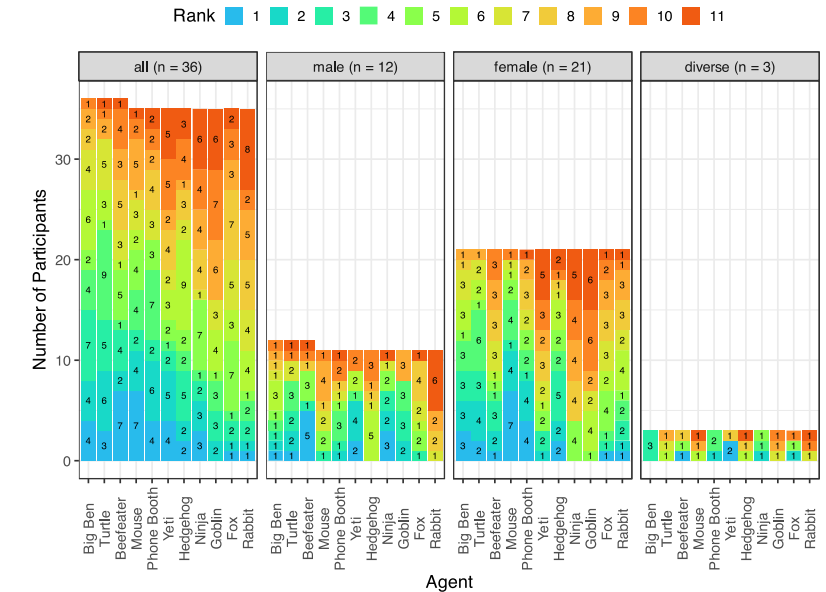
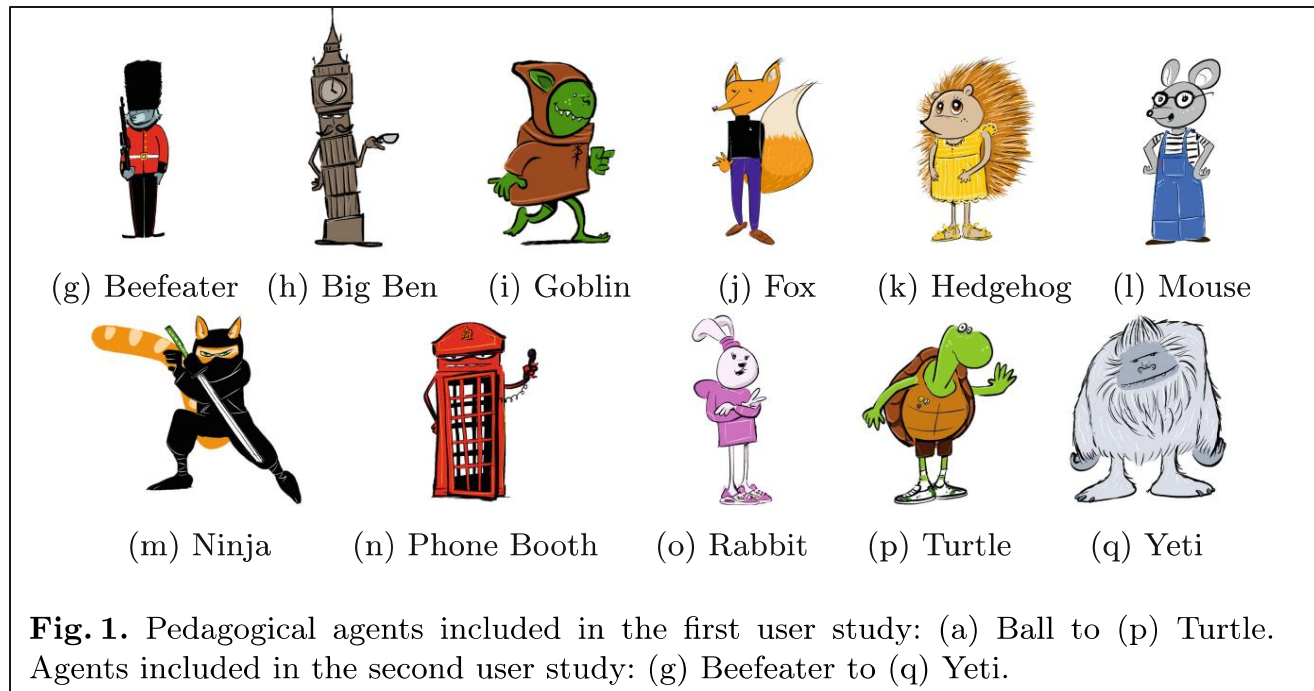


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Second User Study: Results

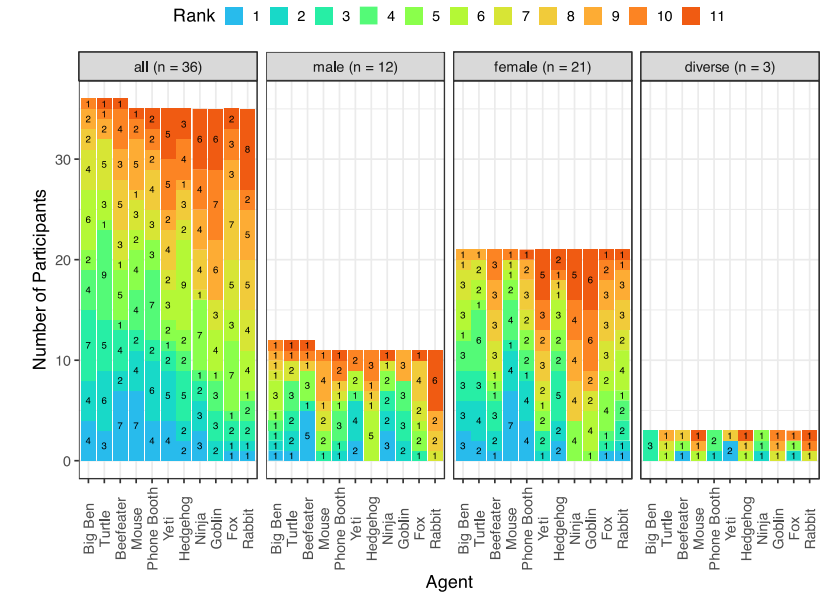
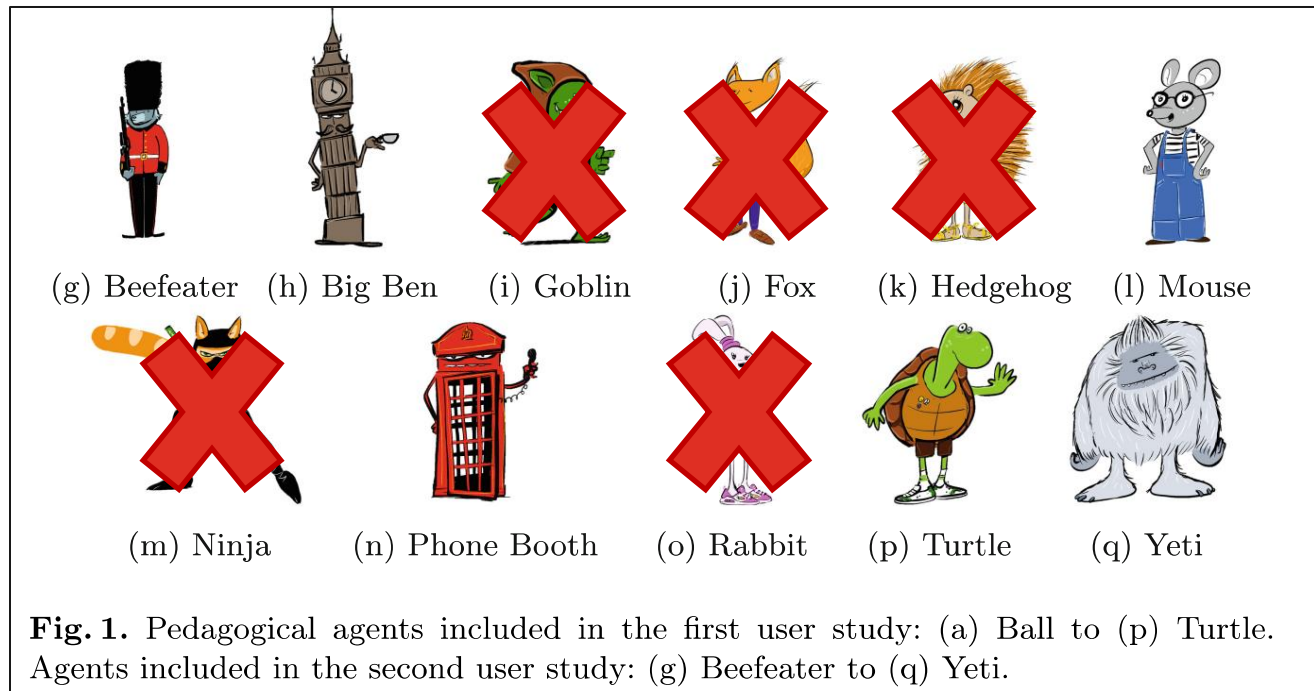


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Second User Study: Results

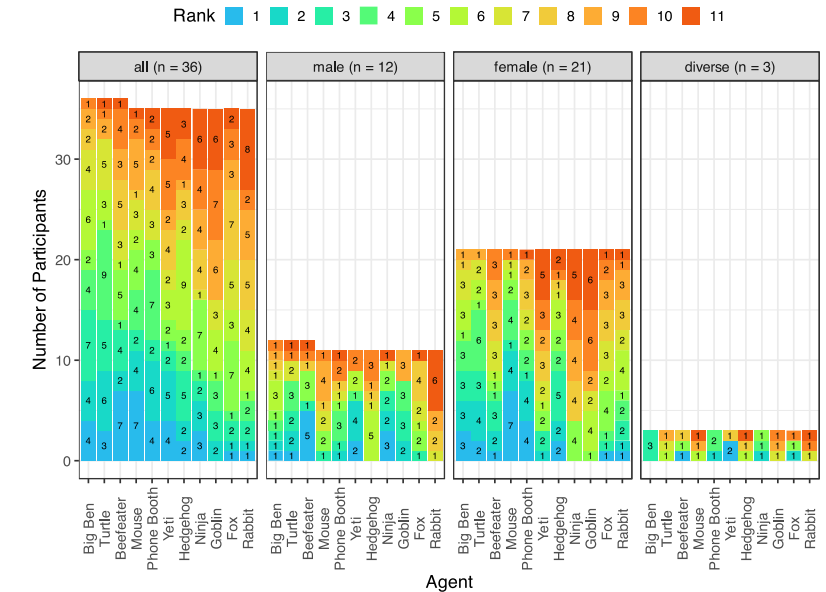
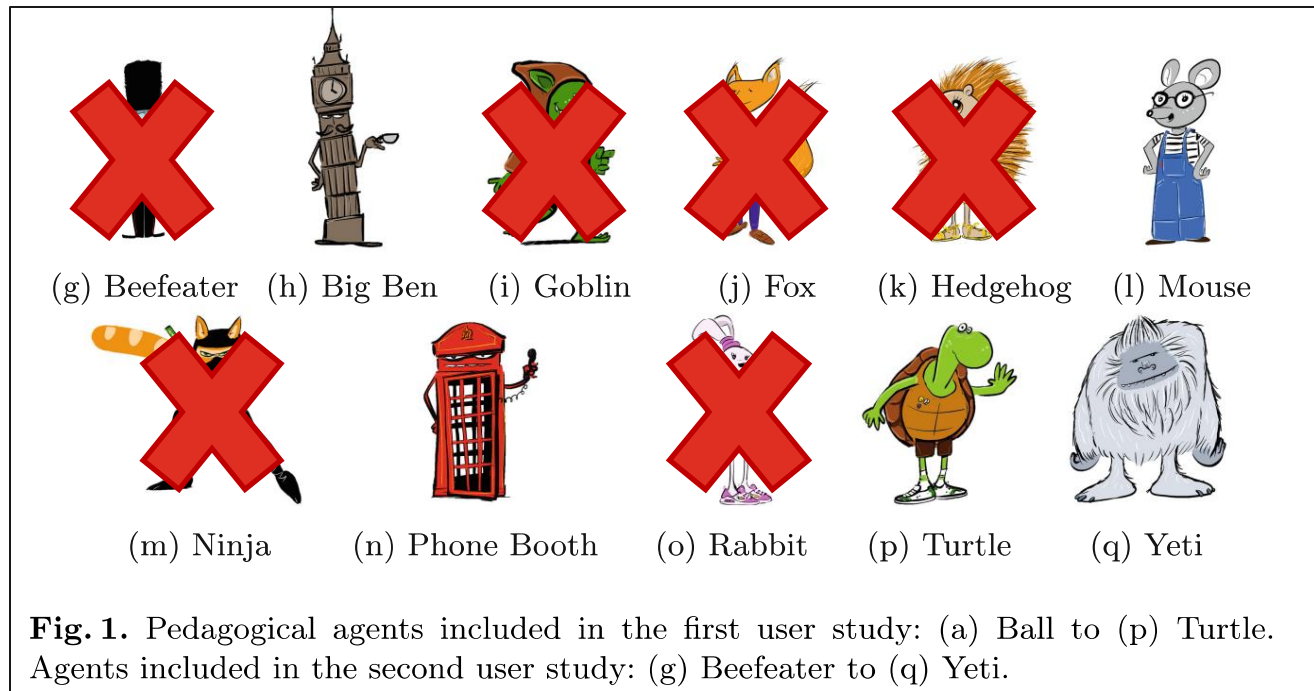


Table 1: Students' reasons for picking their favorite agent in the second user study, summarized across the reasons' ranks.

| | Total | Big Ben | Beef-Turtle | Beef-eater | Phone Mouse | Phone Booth | Yeti | Hedgehog | Ninja | Fox | Rabbit |
|------------------------------------|-------|---------|-------------|------------|-------------|-------------|------|----------|-------|-----|--------|
| looks likeable | 17 | 1 | 1 | 2 | 4 | 3 | 2 | 1 | 2 | - | 1 |
| I like the animal/character | 14 | 1 | 2 | 1 | 1 | 3 | 1 | 2 | 2 | - | 1 |
| looks cute | 13 | 1 | 2 | - | 7 | 1 | - | 2 | - | - | - |
| best drawn | 13 | 1 | - | 2 | 3 | - | 4 | - | 3 | - | - |
| speaks English well | 12 | 3 | - | 4 | 1 | 3 | - | - | 1 | - | - |
| looks funny | 12 | 3 | 2 | - | 1 | 2 | 2 | - | 2 | - | - |
| looks like he/she/they knows a lot | 11 | 4 | - | 2 | 3 | - | - | - | 2 | - | - |
| least childlike | 10 | 1 | - | 3 | 1 | 2 | 1 | - | 2 | - | - |
| looks smart | 9 | 1 | 1 | 2 | 3 | - | - | - | 1 | 1 | - |
| can teach me something | 9 | 1 | 1 | 2 | 1 | 1 | - | 1 | 1 | 1 | - |
| can give good feedback | 8 | 2 | - | 1 | 1 | 1 | - | - | 1 | 1 | 1 |
| looks supportive | 7 | 1 | 1 | 2 | 1 | 1 | - | - | 1 | - | - |
| looks athletic | 6 | 1 | - | - | - | - | 2 | - | 3 | - | - |
| looks cunning | 4 | 1 | - | - | 1 | - | 1 | - | 1 | - | - |
| I can identify with her/him/them | 3 | 2 | - | - | - | - | - | - | 1 | - | - |

Second User Study: Results

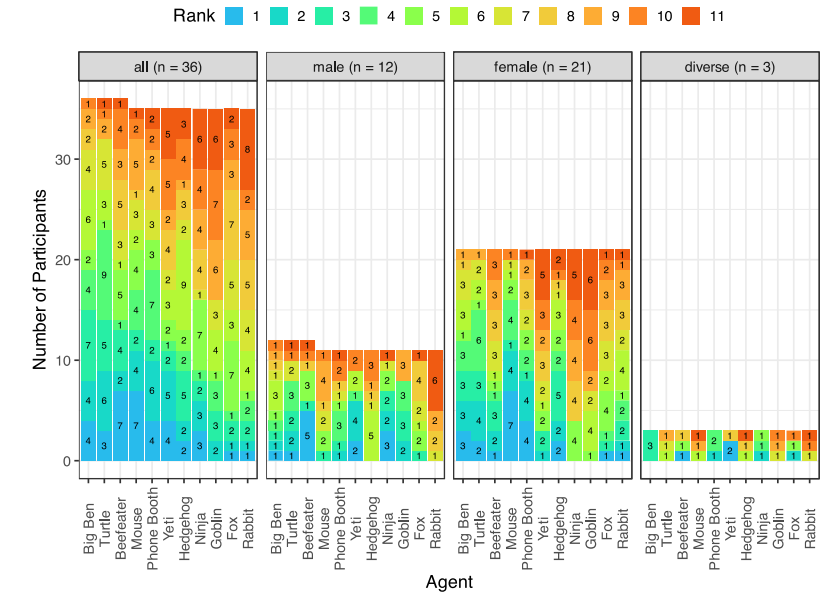
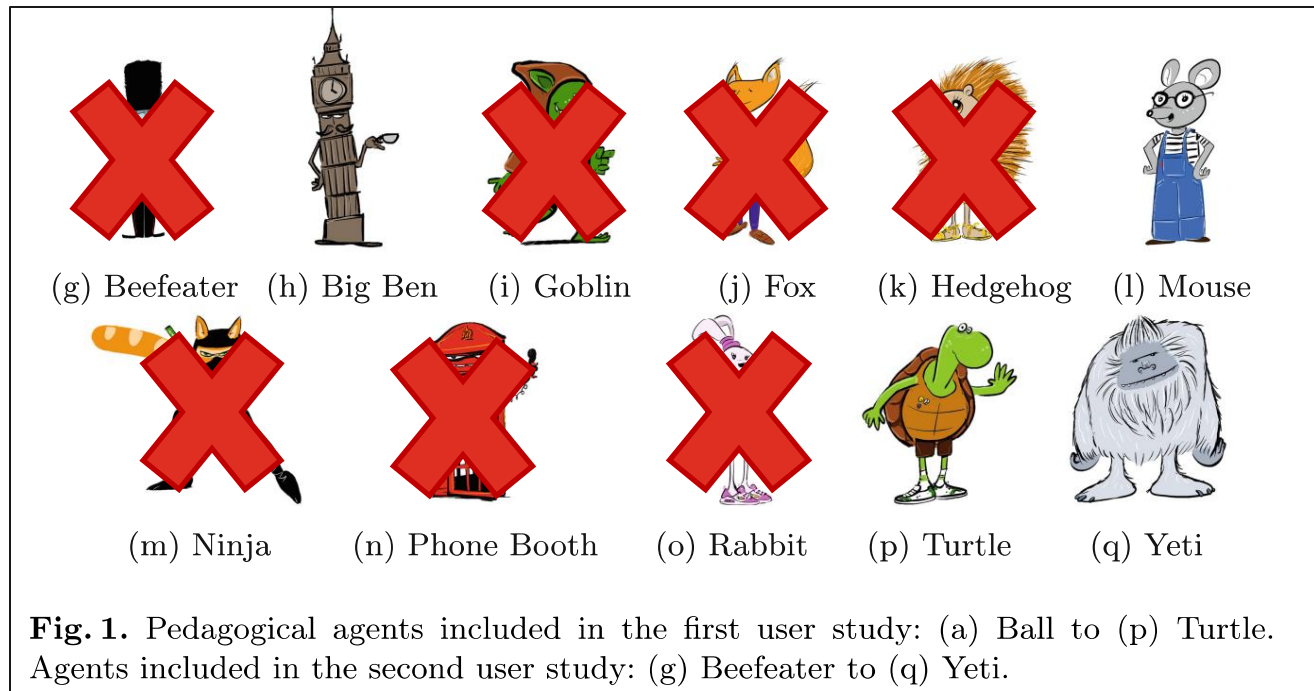


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| best drawn | 13 | 1 | - | 2 | 3 | - | 4 | - | 3 | - | - |
| speaks English well | 12 | 3 | - | 4 | 1 | 3 | - | - | 1 | - | - |
| looks funny | 12 | 3 | 2 | - | 1 | 2 | 2 | - | 2 | - | - |
| looks like he/she/they knows a lot | 11 | 4 | - | 2 | 3 | - | - | - | 2 | - | - |
| least childlike | 10 | 1 | - | 3 | 1 | 2 | 1 | - | 2 | - | - |
| looks smart | 9 | 1 | 1 | 2 | 3 | - | - | - | 1 | 1 | - |
| can teach me something | 9 | 1 | 1 | 2 | 1 | 1 | - | 1 | 1 | 1 | - |
| can give good feedback | 8 | 2 | - | 1 | 1 | 1 | - | - | 1 | 1 | 1 |
| looks supportive | 7 | 1 | 1 | 2 | 1 | 1 | - | - | 1 | - | - |
| looks athletic | 6 | 1 | - | - | - | - | 2 | - | 3 | - | - |
| looks cunning | 4 | 1 | - | - | 1 | - | 1 | - | 1 | - | - |
| I can identify with her/him/them | 3 | 2 | - | - | - | - | - | - | 1 | - | - |

Second User Study: Results

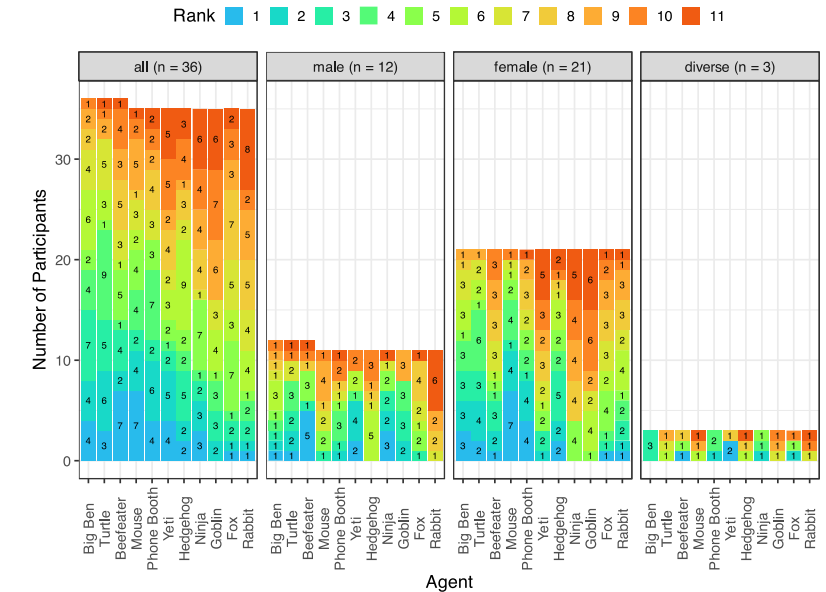
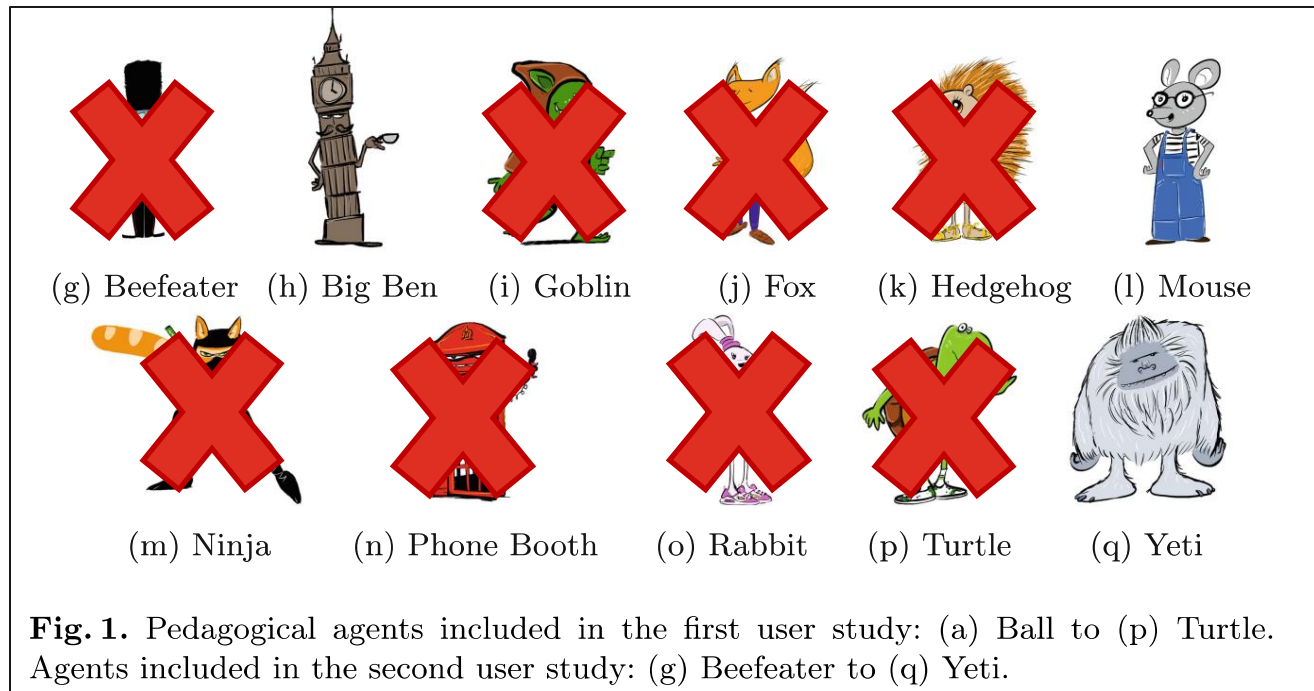


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| looks supportive | 7 | 1 | 1 | 2 | 1 | 1 | - | - | 1 | - | - |
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| looks cunning | 4 | 1 | - | - | 1 | - | 1 | - | 1 | - | - |
| I can identify with her/him/them | 3 | 2 | - | - | - | - | - | - | 1 | - | - |

♥ Lernbuddy (BITTE NACH UNTEN SCROLLEN)

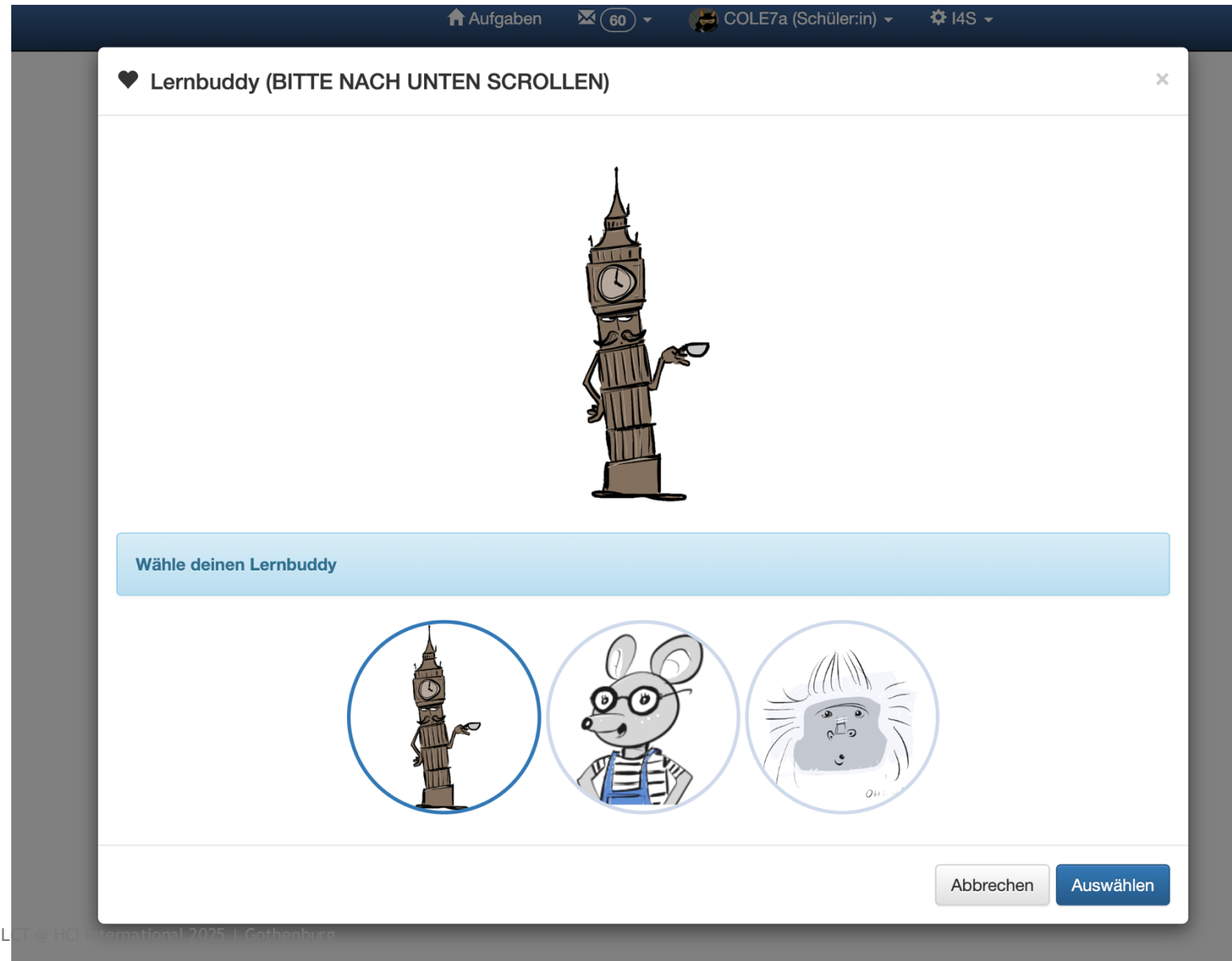


Wähle deinen Lernbuddy



IMPLEMENTATION IN THE FEEDBOOK SYSTEM

Implementation in the FeedBook System



Implementation in the FeedBook System

A screenshot of the FeedBook system interface showing a feedback summary pop-up. The background shows a grammar exercise with a text completion task: "Last Monday, Olivia ... New York City. They ... to get married. Jason both ...".

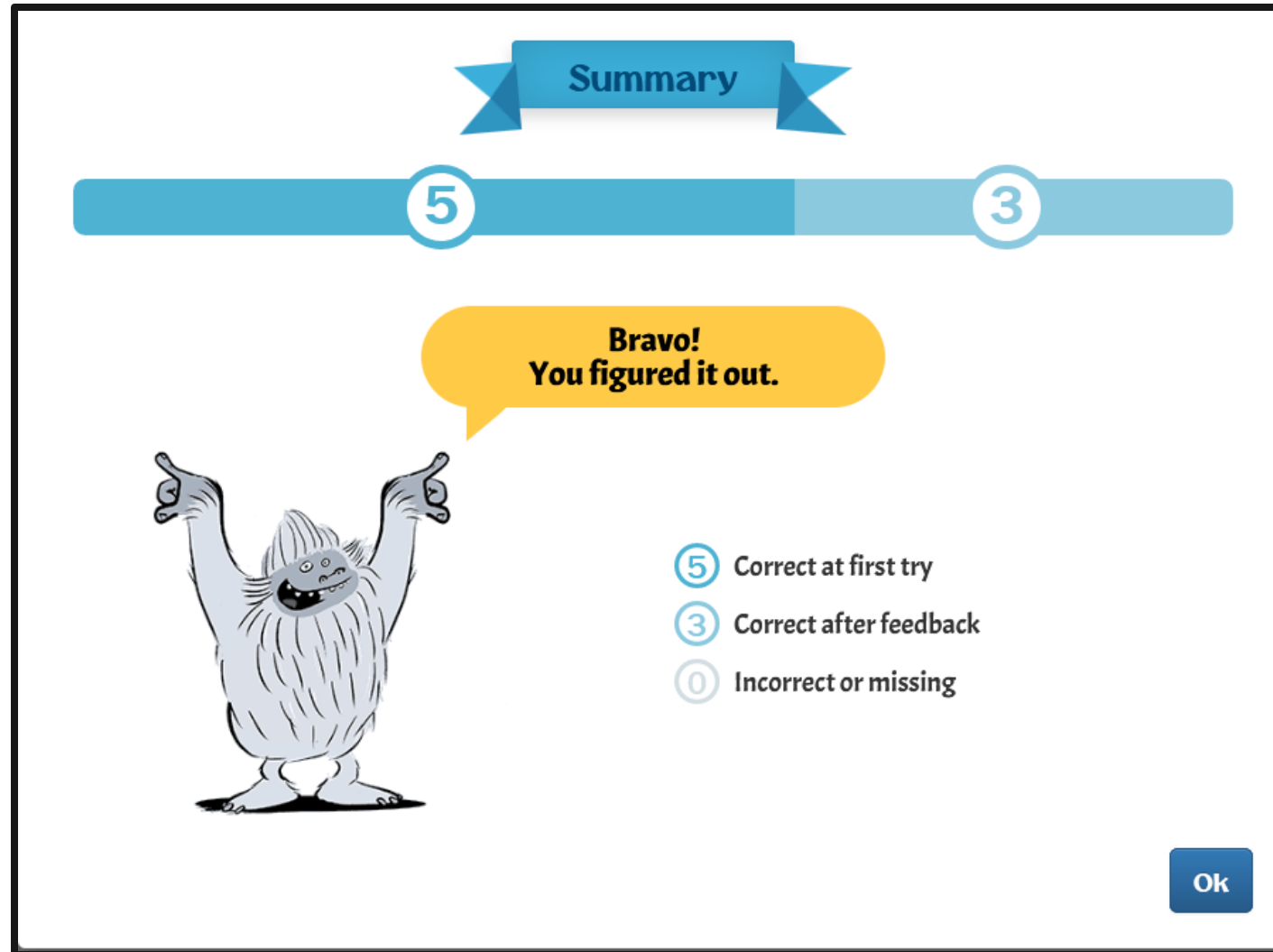
The pop-up window displays a progress bar with two segments: a dark blue segment labeled '5' and a light blue segment labeled '3'. Above the bar is a blue ribbon labeled 'Summary'. Below the bar is a yellow speech bubble saying "Bravo! You figured it out." and a cartoon illustration of a blue, furry creature.

A legend on the right side of the pop-up explains the scoring system:

- ⑤ Correct at first try
- ③ Correct after feedback
- ① Incorrect or missing

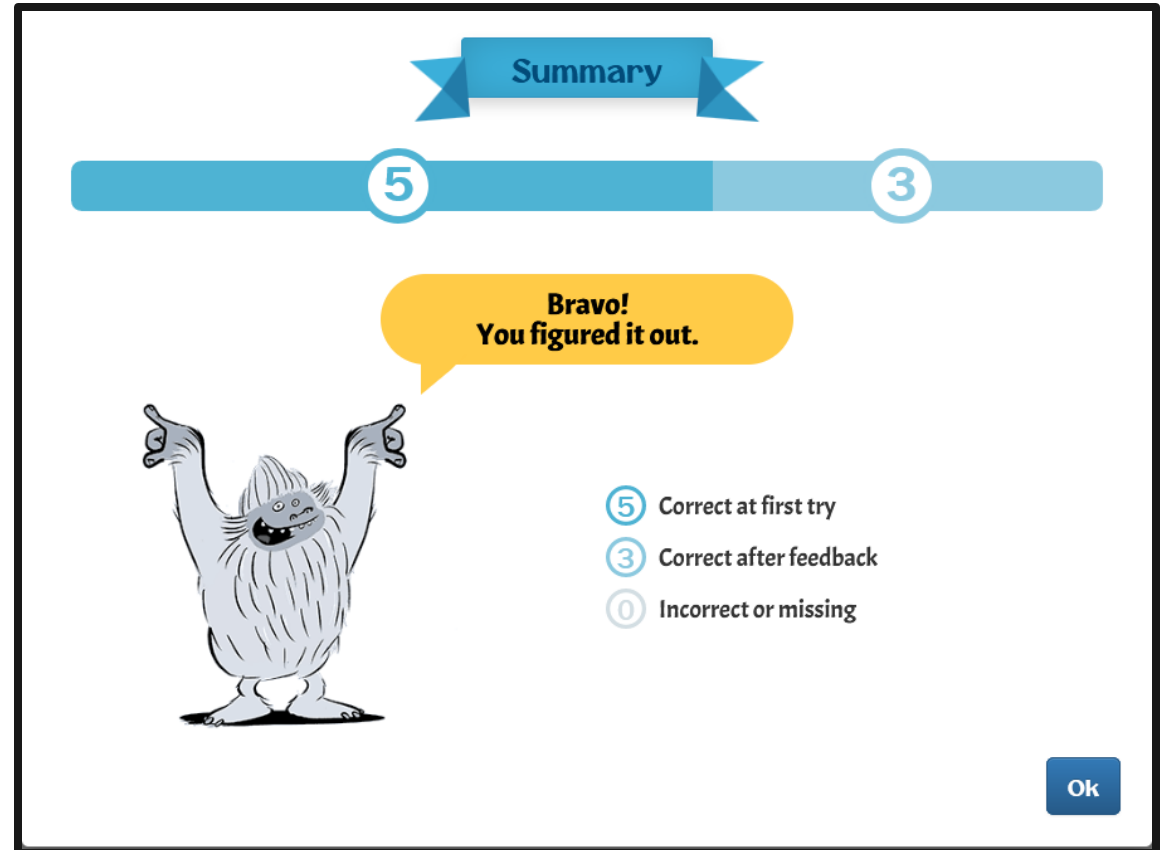
An "Ok" button is located at the bottom right of the pop-up.

Implementation in the FeedBook System



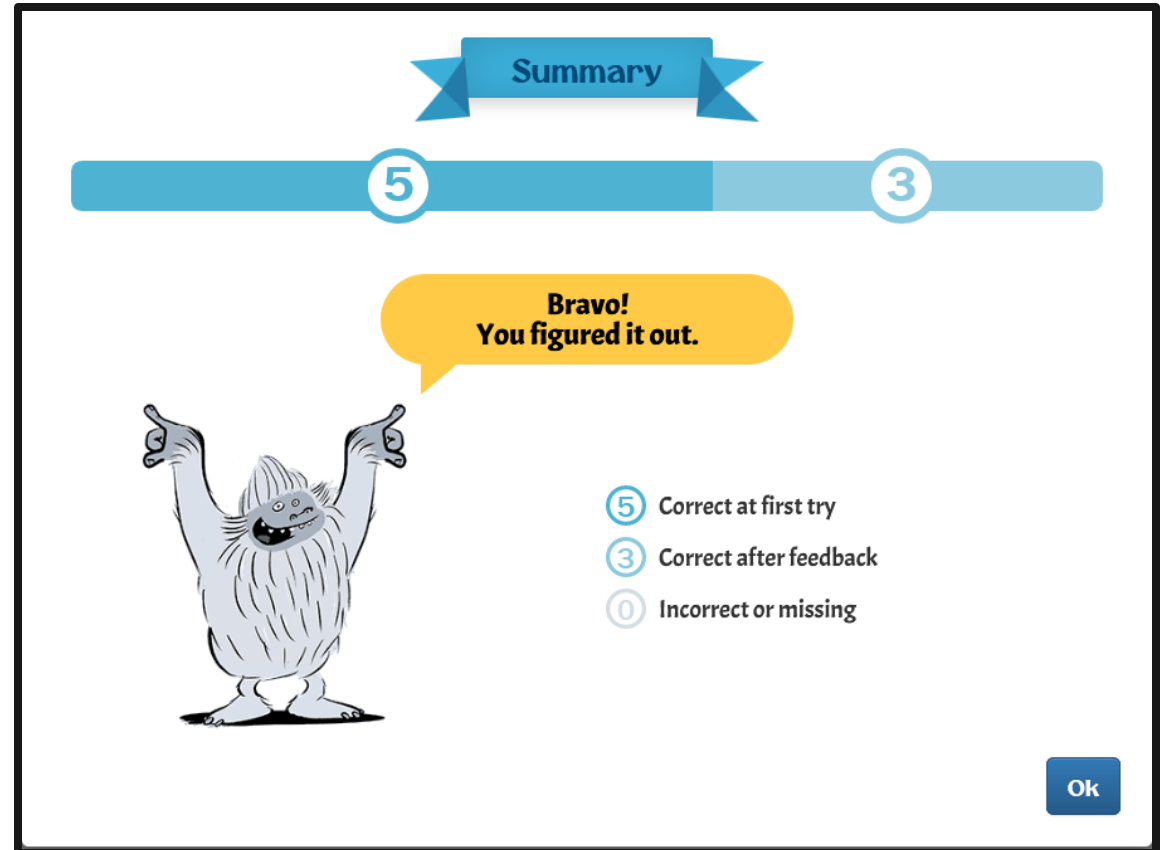
Preliminary Results of the Impact on Learning Effectiveness and Motivation in the RCFT

- We investigated the efficacy of the pedagogical agents in fostering students' performance in an English test and their English motivation in a large-scale field study with over 600 seventh-grade students occasionally practicing with the system over one school year (Parrisius et al., 2023)



Preliminary Results of the Impact on Learning Effectiveness and Motivation in the RCFT

- Agents were perceived very positively by the students
- Students working with FeedBook including the agent and a novel student dashboard achieved better results in an English test after the first 2–3 weeks
 - However, we found subsequent negative effects throughout the rest of the school year on students' English performance and English motivation
 - fading effect or even a reversal of possible novelty effect?
 - likely due to the way the agent was presented to the students, how often, and for how long



Summary

1. Pedagogical agents (PA) can be used in intelligent tutoring systems (ITS) to address the lack of interaction to foster students' motivation
 2. A multi-step process revealed the preferences and reasoning of 7th-grade students to choose their favorite PA for an ITS for EFL
 - In line with the expert hypothesis, UK-themed characters were most often attributed to speak English well and know a lot
 3. A subsequent randomized controlled field trial (RCFT) proved the PA's positive perception
 - but revealed mixed findings w.r.t. English performance and English motivation pointing to an initial novelty effect that then reverses
- Future analyses and RCFT need to investigate the impact of pedagogical agents, specifically regarding their implementation

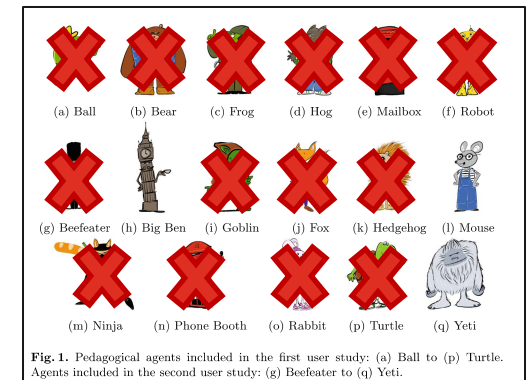
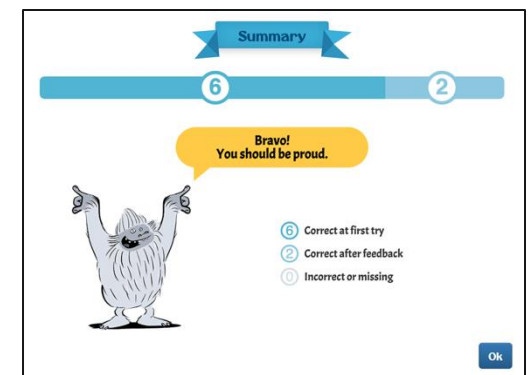


Fig. 1. Pedagogical agents included in the first user study: (a) Ball to (p) Turtle. Agents included in the second user study: (g) Beefeater to (q) Yeti.



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Thank You!



Questions?

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