



Where's Grandpa? A Visual Novel designed to teach children with Autism about the past tense

Developing Educational Games for teaching children with Autism

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Declaration

I declare that this thesis was composed by myself, that the work contained therein is my own except where explicitly stated otherwise in the text, and that this work has not been submitted for any other degree or professional qualification.

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Abstract

This thesis focuses on the design and implementation of a serious game to teach children within the Autism Spectrum Conditions language skills. Specifically, the game focuses on teaching regular past tense verbs to children with Autism. Research shows that Autism co-occurs frequently with Specific Language Impairment and that difficulties with regular past tense can last throughout adolescence. A literature review is conducted which led to the decision to use a Visual Novel, a game genre that originated in Japan, to teach regular past tense verbs. Workshops with Typically Developing children and interviews with experts are carried out to inform the design of the game. The final prototype is described and further evaluations with Typically Developing children and experts are done to explore areas for improvement. Finally, further work for the future is suggested based on the themes of simplicity and representation.

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Chapter 1: Introduction

Children with Autism are children who fit the criteria for Autism Spectrum Conditions (ASC), hereby referred to as children with Autism, as defined by the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (APA, 2013). Such children have persistent issues in social communication and social interaction, meaning that their language development may not match that of typically developing (TD) children. These issues may be accompanied by a language impairment, including co-morbidity with Specific Language Impairment (SLI), two developmental disorders that co-occur frequently enough that the subgroup of children with Autism with SLI has been coined Autism Language Impairment (ALI) (Leyer et al., 2008; Lindgren et al, 2009; Tomblin, 2011).

1.1 Research Objectives

This paper looks into how a game designed for a tablet can help children with Autism learn regular past tense verbs. The study addresses the following questions along the way:

1. What type of game would be best to teach regular past tense verbs?
2. How can the game be designed such that it can be fun and engaging for the target group?

After the literature review and a game type chosen, a third question comes to the fore.

3. Are Visual Novels viable as an educational game?

To answer these questions, a summary of the work undertaken is shown below:

1. A range of activities that inform the design of the game, including a literature review, running workshops with children, and interviews with experts.
2. The creation of a tablet game using the Fungus asset bundle in Unity 5 that teaches regular past tense verbs.
3. Repeated testing of the game via prototypes, usability studies, prototype evaluation with experts, and feedback from TD children.

1.2 Structure of the dissertation

The chapters below are arranged as follows:

Chapter 2: A literature review is conducted. This section reviews the difficulties that children with Autism face in relation to language use. It also reviews what serious games are and what games have already been implemented to teach children with Autism.

Chapter 3: The methodology used to design the game is discussed and expanded. This section explores the CARSS framework.

Chapter 4: The workshops conducted with TD children and the interviews with experts are reviewed, with a conclusion in each sub-section that summarises the findings.

Chapter 5: The final prototype is described

Chapter 6: The feedback from experts and children on the final prototype is discussed.

Chapter 7: A discussion and conclusion of what this thesis has achieved and what future work can be carried out is reviewed.

Chapter 2: Literature Review

This section is aimed at giving an overview of what Autism is, what difficulties children with Autism face in learning regular past tense verbs, methods used to teach children with Autism regular past tense verbs, and how games and other computer-based interventions have been used in learning.

2.1 Autism

Autism Spectrum Conditions (ASC) is a set of disorders that include what was previously individual disorders, such as Asperger's disorder and childhood disintegrative disorder (Lauritsen, 2013; APA, 2013) affecting 1 in 88 children in the US in 2008 and 4 per 1000 8-year old boys in UK (Taylor et al., 2013).

ASC is characterized by 'persistent deficits in social communication and social interaction across multiple contexts' and 'restricted, repetitive patterns of behavior', such as lining up toys or repeated speech. This may or may not be accompanied by a language disorder (APA, 2013). However, as stated in the introduction, ASC and SLI frequently co-occur together, and affect aspects such as pragmatics (Eigsti et al., 2011).

2.2 Autism and regular past tense verbs

After Tager-Flusberg (2004) found that ASC and SLI co-occurred frequently, Roberts et al. (2004) found deficits in both third-person regular tense and past tense markings in the impaired language subgroup of children. Omission of markers were the most common deficit, the same deficit children with SLI face. However, the substitution of other markings was also used by the children, such as '-ing' for 'he fixing the teeth' instead of 'he fixed the teeth'. They suggested that these errors reflect the primary deficits in pragmatics that children with Autism face (Tager-Flusberg, 2000). Finally, they also found that IQ scores had no significant correlation to tense marking performance, with low IQ scoring children performing well and vice versa.

Eigsti & Bennetto (2009) had 21 children and adolescents with autism between 10-17 years of age and 22 TD children, with unspecified ages, judge the grammaticality of English Syntax and Morphology. 140 sentences, half of which were grammatical and half of which were not, were presented. These sentences included past tense verbs and markings. They found that group differences between children and adolescents between 10-17 years of age missed significance for past tense marking compared with TD children. However, the ASC group still showed impairments in the use of third person singular marking and in past tense marking, resulting in errors of omission and substitution, described above, and insertion

and movement. Insertion is where a tense marking is used where an unmarked word should be, and movement is where words are shifted around in a sentence.

While these results do not fit with the hypothesis that there is a subgroup of autism that have language impairments like SLI, they do note that their results support the Extended Optional Infinitive hypothesis. This hypothesis states that children will accept ungrammatical sentences because they are delayed in realizing that finiteness markings are required in sentence construction in English.

Walenski et al. (2014) addressed issues they found in previous studies, including Roberts et al. (2004). One of the changes they made was in limiting social interaction with the children when gathering the data to reduce the effect of the social impairment found in children with Autism. The results were that the boys with autism did not differ in accuracy from TD boys when producing both regular and irregular verbs and that regular verb accuracy was higher than irregular verb accuracy for both groups. However, they found that children with Autism responded more quickly than the TD control group.

Modyanova et al. (2017) investigated verbal induction production in two subgroups, children with Autism with language impairment (ALI) and children with Autism with normal language development (ALN) and compared them to TD children in a tense-marking task. They found that the ALI group showed 'extensive deficits with finiteness' which manifested itself in, among other language phenomena, simple and past tense. They concluded that ALI children had a disrupted language development, with difficulties in grammar. In contrast, the ALN group showed slower development of finiteness compared to TD controls matched on age.

This section suggests that whether or not there is a subgroup of children with Autism with language difficulties, there is evidence to suggest that children with Autism struggle with identifying ungrammatical sentences from grammatical sentences, which include identifying regular past tense verbs. The idea that regular past tense verbs should be taught to children with Autism of ages between 5-10 seem reasonable as they may have a delayed language development that can last up beyond the childhood years, as Eigsti & Bennetto (2009) shows.

2.3 The use of games in learning

Computer-based interventions for teaching children with Autism language skills that include, but are not limited to, video games can be found as early on as 1973, where Colby (1973) discusses the principles that underlie computer-based treatment for language difficulties.

More recently, Williams et al. (2002) concluded that children with autism spent more time reading on computer than through books, with less resistance to its use. A computer-animated tutor, Baldi, that taught vocabulary and grammar (Bosseler & Massaro, 2003), shows that children with Autism can learn a new language with a computer-animated agent and multimedia in a way that transfers to a natural, uncontrolled environment. All this suggests that computer-based interventions can be successfully used to teach language skills, including the regular past tense, to children with Autism.

This means that video games, which are games played on a computer or a console like the Playstation, can be an effective means of education if adapted properly. Video games have been defined as a collection of loose features such as the simulation of physics in real time and the allowance of other instantaneous communication (Squire, 2008). For the purpose of this paper, the salient features include the player taking the role of a different character in games. This may be represented in third person, where the player controls an avatar or sprite, which are drawings or animated computer models, of their character on screen. Alternatively, it may be in first person, where the player does not see an avatar or sprite and the player uses the computer screen ‘to see through the eyes of their character’ (Schneider et al., 2004). Another feature is the ability to make choices in game (Chen, 2007).

Games are now in use for learning in the military (Hussain et al., 2009) and its ability to aid children in learning has been studied extensively (Kirriemuir & Mcfarlane, 2004; Gee, 2008). The principles used in video game design that lead to fun and engagement are related to principles that lead to learning. Gee (2008) comes up with 36 principles that we can extrapolate from video games that tell us about learning. Games are also used in teaching English: Yolageldili & Arikan (2011) found that games were viewed as an important tool in teachers teaching English as a foreign language in primary schools.

In fact, games have been used to teach children with Autism face recognition skills (Tanaka et al., 2010), to shopping and transportation (Lányi & Tilinger, 2004). Zakari et al. (2014) reviews no less than 40 serious games designed for children with autism spectrum disorder. Therefore, there seems to be no issue with extending the use of video games to teach regular past tense.

This success can be attributed to children with Autism playing video games more than typically developing peers (Mazurek & Engelhardt, 2013). This suggests that games that lead to learning have a bigger likelihood of engaging such children and lead to successful learning. Durkin et al. (2013) shows that children with Autism are ‘strongly attracted to screen-based entertainment’ and that such children are not necessarily disadvantaged when it comes to gaming. In fact, since video games are based on logic and

use cause-and-effect relationships, some children with Autism may show superior skills on this front (Baron-Cohen et al., 2009). This means that those children who have Autism and are engaged in video games should do well in at least one aspect of games (Durkin, 2010).

Games can be categorized into different genres, from shooting games where players use guns to eliminate other players, like *Counter-Strike*, to Role-playing games, where players act as a character to fulfil certain goals as they progress through the game. Prensky (2005) studied which game genre is most effective when learning different skills. In this case, players are learning a language skill, and role-playing games are most suitable for this aspect. These games tend to have an emphasis on story, where challenges are presented to the player for them to overcome according to a fixed set of rules (Randi & Carvalho, 2013).

Visual Novels (VN) appear to be the best fit for this project. Described as similar to a ‘choose your own adventure’ book (Lebowitz & Klug, 2011), the story is told via text and dialogue in first-person mode. However, unlike books, VNs contain background images based on where the character is and what he sees, and facial/full-body portraits of characters they are interacting with. These portraits are not animated but can be in various poses to express different emotional states. VNs also usually include spoken dialogue and background music. These serve to immerse the player more than what a book can. This genre has slowly been introduced outside of Japan, with games such as *Doki Doki Literature Club*, a horror game, and *Katawa Shoujo*, a dating simulator, being two recent examples of VNs that have been made for a non-Japanese audience.



Figure 1. Screenshots from the games a) Doki Doki Literature Club and b) Katawa Shoujo respectively. In a), the character Monika is commenting on the main character's likes, while in b), the player is about to make a choice as the main character. Both main characters do not have sprites on screen as the games are in first-person.

Gameplay in VNs normally come from branching story paths, with the player choosing certain options at various points of the game. Some of these choices lead to bad endings, such as the player character's death, while others lead to entirely different endings. Some of these branching paths can remain hidden from the player, dependent instead on previous choices that have accumulated. Not all VNs have branching paths. A subset of VNs, called Kinetic Novels, have no alternate different endings. An example is the *Ace Attorney* series, where players control Phoenix Wright, a defense attorney who goes through attorney cases in a linear fashion.



Figure 2. Screenshot from the game Apollo Justice: Ace Attorney. Here, the player as the main character, Apollo Justice, is about to present evidence from their inventory to show a contradiction in Olga's testimony.

Chapter 3: Design Methodology

The most important factor for the game is that it is designed for children with Autism. As the target audience is not considered ‘typical’, the design methodology needs to consider how best to design a game for such children; assumptions and decisions that might be made from a designer’s standpoint might not hold and must be carefully picked apart.

There are several design methodologies that seem feasible at first glance. There is Co-operative design (Bjerknes et al., 1987), Participatory Design (Blomberg & Henderson, 1990), and Consensus Participation (Mumford & Henshall, 1979). As their names imply, all these design methodologies involve the user in some way. Fletcher-Watson (2014) found that Participatory Design (PD) is considered best practice when designing for users outside of the mainstream audience.

PD originally spawned from the Scandinavian workplace, where changes in business management led to an increased emphasis on participation and joint decision-making in workplaces. (Bjögvinnsson et al., 2012). PD is made of two criteria. First, it is a situation where two or more persons work together in designing the item. Second, there are two or more categories of people present (Read et al., 2002). Applied to game design, this means there should be joint decision-making between the designer and, ideally, two or more children with Autism, where ‘adults’ and ‘children with Autism’ are two different categories.

This raises questions about the efficacy and process of PD as applied to children. First, is it possible to use a design process made for adults with children, let alone children with Autism? Second, even if it is possible, how are we to include children with Autism in game design?

In answering the first question, Druin (1999) and Druin (2002) notes that children can take the roles of user, tester, informant, and design partner. Explaining their role as a design partner, Druin says that while children must learn their role as design partners while navigating a power structure with the adults, they eventually understand their role in the design process. The impact on the technology varies depending on the design team’s experience and rapport, but the impact on children is clearer, where they end up feeling empowered and challenged as they are treated as equals with adults. This gives a clear indication that PD can be applied with children too.

Answering the second question, Benton et al. (2011) propose an Interface Design Experience for the Autistic Spectrum (IDEAS), a session based PD method for children with Autism. This was extended in Benton et al. (2012) to involve the children in multiple design sessions. They found that children with

Autism were able to participate and collaborate with other children in designing a math game. This suggests that PD methods are useful when designing a game with children with Autism.

For this thesis, there was no way to work with children with Autism. Instead, the workshop sessions described below involved TD children as proxies. The use of proxies is a viable alternative as TD children that are within or older than the age range can explain their rationale for their ideas (Fletcher-Watson et al., 2016).

3.1 Process of design with children

Most serious game design methodology research do not explicitly combine them with participatory design. One exception to this is Khaled & Vasalou (2014), who carried out two design workshops involving children for their game ‘Village Voices’ that taught conflict resolution. They found that children were most effective participants during the middle stages of game design. Boundary objects, themes and items used in defining the problem space, should be more specific than open-ended as they provided scaffolding for the children. They also noted that children in this generation are heavily exposed to games and thus have a high degree of game literacy. Because of time constraints, the workshop occurred in the early stages of game design.

CARSS was the chosen framework in serious game design methodology with PD design. CARSS is a framework for learner-centered design with children by Good & Robertson (2006). CARSS is rooted in distributed cognition, made for designers wishing to create educational games, and considers the roles taken up by different stakeholders when in the process of design. The design system has parallels to cognitive processes distributed across itself, encouraging coordination between internal and external structure.

The different letters in CARSS stand for **C**ontext, **A**ctivities, **R**oles, **S**takeholders, and **S**kills and a summary of it is shown in Figure 3 below, taken from Good & Robertson (2006). The following sections explores these different areas in turn.

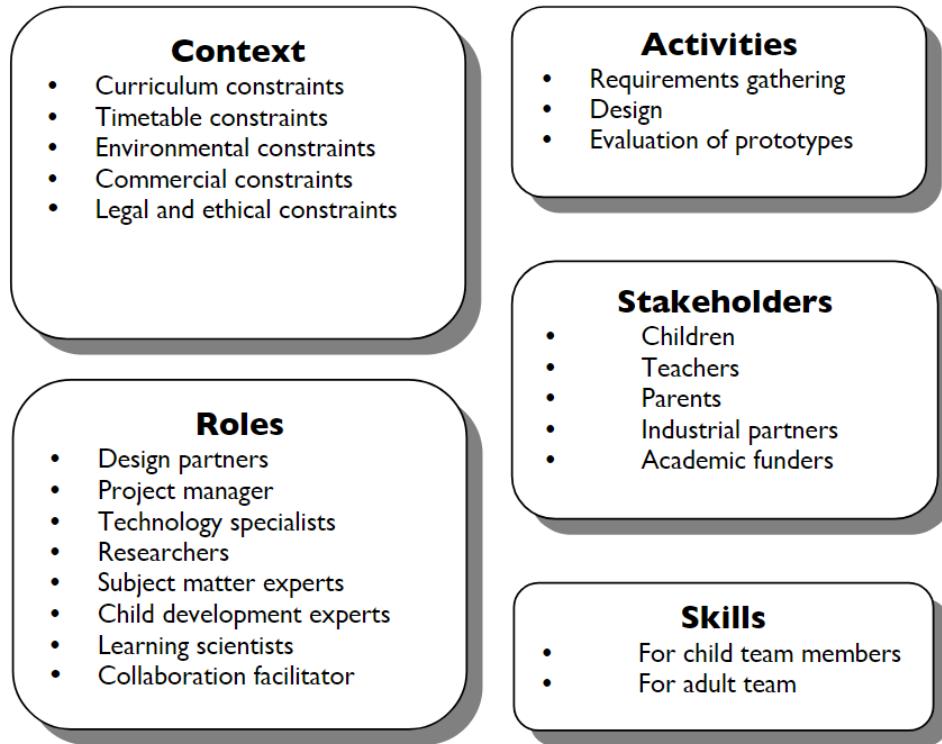


Figure 3. The CARSS framework. Figure taken from Good & Robertson (2006).

3.2 Context

There are several constraints to consider here, including curriculum, timetable, environmental, commercial, and legal and ethical constraints.

As explored, the designed game is constrained to teach past tense. Time is constrained as workshops lasting approximately 30-40 minutes were the only interactions possible with children. The workshops took place in a quiet, sizable room within the university, and funding was not an issue as low-tech prototypes and technology such as pen and paper were used. Legally and ethically, a form detailing their rights to leave the workshop at any time without requiring permission from the researchers was given to the children; another form regarding the parents' permission for participation was given to the parents to sign.

3.3 Roles and stakeholders

Roles are the various functions the members of the design team can fulfill. In contrast, stakeholders are the groups of people that have a vested interest in the design of the game.

The only relevant stakeholders are the children involved in the workshop and the thesis writer. Parents may be considered, but only in the sense that they give their children permission to participate in the workshop. There are no industrial partners involved and no academic funding was accessed. Turning to the roles taken up by the stakeholders, children are seen as design partners within the CARSS framework. Parents of children with Autism and other experts were brought in as subject matter experts to discuss the game, following Fletcher-Watson (2014) where such experts further enhance the quality of the game.

As the only other party involved in this game, the writer played the role of project manager and researcher, ensuring that deadlines are met, planning the activities, and ensuring the workshops went well.

3.4 Activities

The activities section is split into three different sub-sections, requirements gathering, design, and evaluation of prototype.

Requirements gathering is split into further sub-sections. One of them involves the analysis of curriculum guidelines and is not relevant as this game does not follow a curriculum. A second and third sub-section involves analyzing children's works and teachers' assessments to identify common errors in past tense and observing current practice to better provide feedback in the game. As such material was not available for this game, a review of the literature available was done as a substitute. The fourth sub-section involved the evaluation of existing software, which was done in the literature review above. Finally, a broad consultation with stakeholders was not relevant, as the only other stakeholders were children and their feedback was taken in from design.

The design section in CARSS endorses the philosophy that children actively generate new design ideas while contributing to new technology. An important notion is that constraints provided and scaffolding of the domain in question leads to creative thought, rather than unconstrained freedom leading to creative thought. Brainstorming is a useful design tool to use, but best results have sessions structured around practical tasks. Such recommended activities include drawing designs on paper, working with an adult artist to sketch interface designs, and low-tech prototyping, which involves the production of conceptual prototypes on non-digital mediums like Lego or plasticine. For the workshops carried out for this game, the focus was on having the children draw their ideas on paper.

Evaluation of prototypes was done after the first iteration of the game was created and involved the children playing the game and having the aforementioned subject matter experts evaluate the game to see if they would use it themselves.

3.5 Skills

While there are no prerequisite skills required in game design for both children and adults, a consideration of the skills available and that can be learnt is important as it involves how the stakeholders involved can be personally impacted.

None of the skills for children mentioned by Good & Robertson seem relevant in this context. This project did not have the children involved for weeks, or even for an hour, so the ability to complete sustained work is not required. The workshop had the children working individually and so the ability to work in groups was not relevant, and the ability to give and receive feedback was not needed as the workshops were to encourage a free flow of any kind of idea that could be used. As only drawings were made, the children did not learn any technical skills.

3.6 Conclusion

Workshops of 30-40 minutes using colouring pens and paper were viable in having children participate in the design of the game.

Chapter 4: Workshops with children and Interviews with experts

4.1 Design workshops with Typically Developing children

4.11 Cooperative Design

To incorporate children's ideas into the game, TD children came to participate in three workshops. These children were invited to participate with permission from their parents. Ages varied between 8-11 years old, within the older range of the target audience of 5-10 years of age. The only idea that was fixed for the games were that it would be scenario based (e.g. the boy kicked the ball; the troll pushed the boulder) and that there would be a virtual character as described below. The goals of the workshops were to determine three aspects of the game:

1. The shape and form of the virtual character, presented in the workshops as the player's partner, that will accompany the player throughout the game.
2. The storyline wherein the individual scenarios that teach past tense will take place.
3. Determine whether it is the case that irregular past tense verbs are harder than regular past tense verbs.

4.12 Ethical considerations

Parents and Children were told of the workshop via email. Those who were interested replied and a parent consent form and child consent form was sent to them. Once questions were answered and consent forms signed, the children were invited to attend the workshop under supervision of the researchers and without any parents nearby.

The participants' ages and gender are shown below in table 1.

Participant	Gender	Age
P1	Female	10
P2	Male	8
P3	Male	9
P4	Male	8
P5	Female	11
P6	Male	11
P7	Male	8
P8	Female	Nearly 11

Table 1: Participants of the three design workshops.

4.13 Materials and location

Only pen and paper technology were used in these workshops. A mobile phone was used incidentally as a recording device for future review. The material used include:

- Name-tags for both researchers and children
- Different coloured pens
- Pencils and erasers (rubbers)
- Several sheets of A4 paper

Two rooms were used for the three workshops, each having at least 3 tables and multiple chairs with ample space for movement around the room.

4.14 Tasks

The workshops lasted 30 minutes each. First, an explanation was provided, where the children were asked how they had arrived at the workshop and 3 things they had done yesterday. Past tense verbs were pointed out. A picture of a boy kicking a ball was shown, after which a picture where the boy had kicked the ball and an owl at the side was shown, with the words ‘Now the boy is done. What has he done? He has ____ the ball.’

The children were given task 1, where they were asked to draw a character of any kind, fantastical or human, that would serve as the partner of the player. This lasted between 5-10 minutes, after which the children were paired up and were told that their partners knew each other and had been on amazing adventures together. They were then given task 2, where they were tasked to either draw or write out what their partners had done together.

Workshop 1

The first workshop was unplanned and was carried out as one of the participants had arrived early before another workshop taking place. To pass the time, the child, P1, went through this workshop. They were paired with another researcher for task 2.

This workshop served as a trial run to see if it could be successful in future workshops. As time was a factor, the tasks were carried out smoothly within 20 minutes. The results were Clare, a girl who was a blue belt in Taekwondo. She was paired up with Bobby the Snowman drawn by the researcher, who could never melt in the sun.

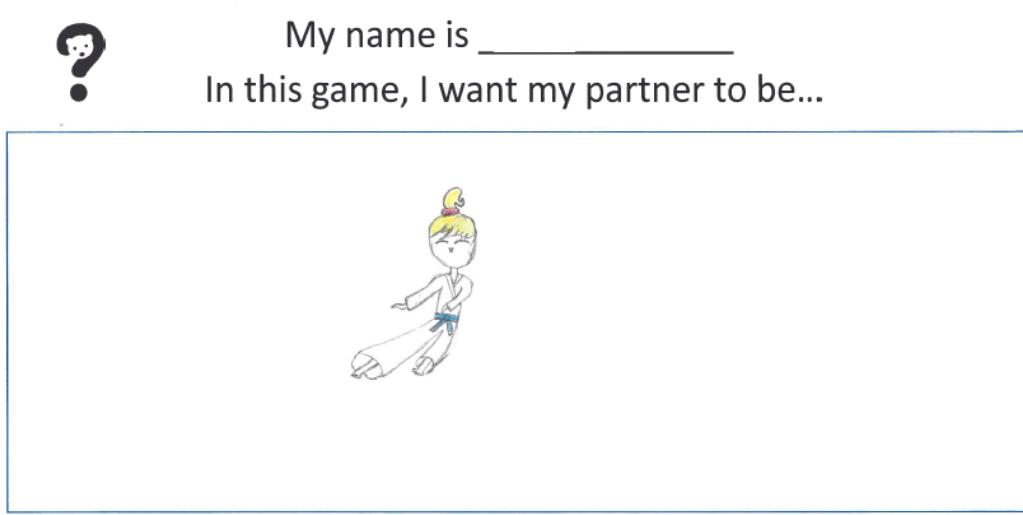


Figure 4. Drawing of Clare, the girl trained in Taekwondo.

The child chose to write instead of drawing her story where the two partners were sneaking into an alleyway that had been reported as haunted and guarded as a result. The two found a ghost when they had snuck in.

Finally, P1 was asked what kind of past tense words they think would be difficult. Interestingly, they thought that irregular verbs like 'had' or 'were' would be easier than regular verbs like 'reported' or 'guarded' because the former were more frequently seen. This suggests that the difficulty might not come from the regularity of the words, but from the lack of exposure and familiarity of the word.

As the workshop ran smoothly, there were no modifications made to the workshop format and material.

Workshops 2 and 3

Workshops 2 and 3 were held one after another. There were 3 participants, all male, in the 2nd workshop, and 4 participants, 2 male and 2 female, in the 3rd. One participant exclaimed that the workshop was like school and the 3 participants in the 2nd workshop were quite restless and distracted, suggesting boredom. With guidance, they managed to complete the workshop. In the 3rd workshop the participants were cooperative at first but were distracted when it came to drawing their story together.

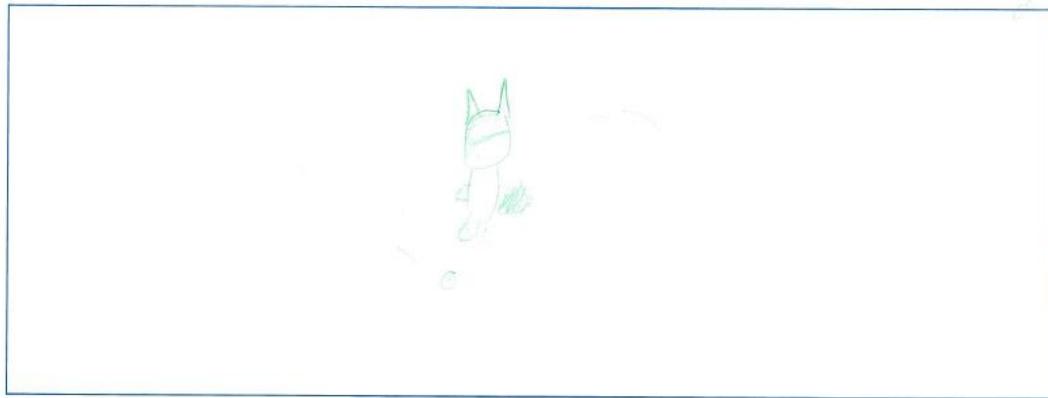
The results of the workshops are as follows.

Ink Botz and Drenched Sock



My name is _____

In this game, I want my partner to be... Ink Botz

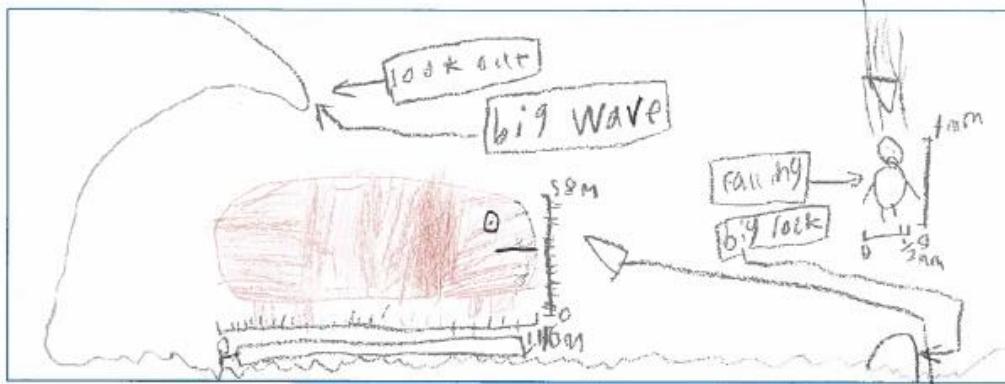


My partner's name will be: Ink Botz



My name is _____

In this game, I want my partner to be...

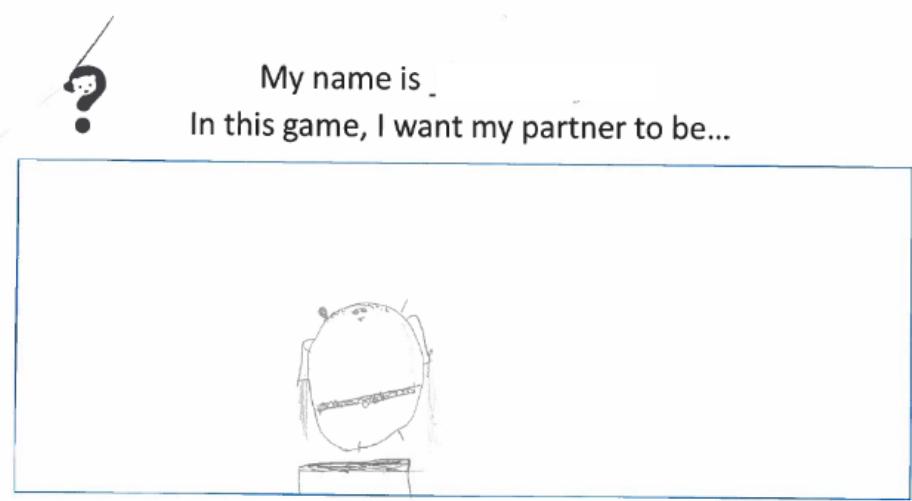


My partner's name will be: DRENCHED SOCK

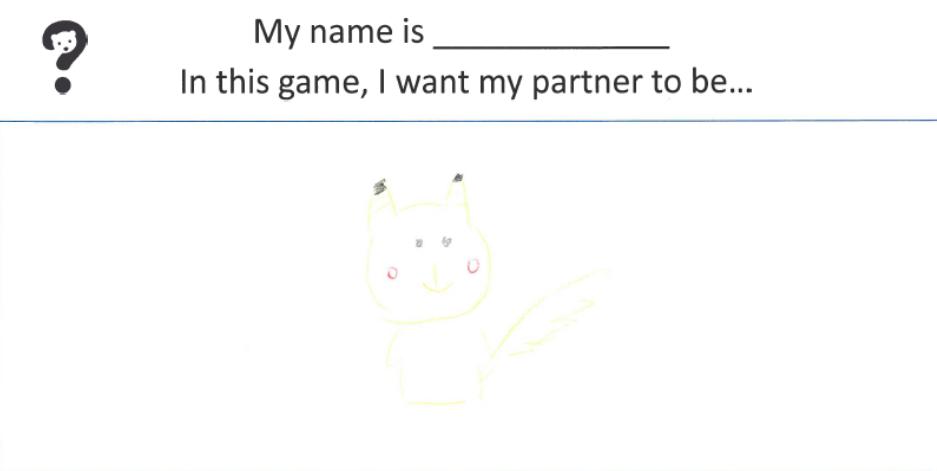
Figure 5. Drawings of a) Ink Botz and b) Drenched Sock, the unlikely pair who ate everything in their paths.

Ink Botz is a robot demon that can turn anything into ink just by touching it, while Drenched Sock is a sock patterned giant guinea pig. Their adventure was an origin story, where both came out from an Ink Botz machine and ate everything in their path.

Madam Idiot and fake Pikachu



My name is _____
In this game, I want my partner to be...



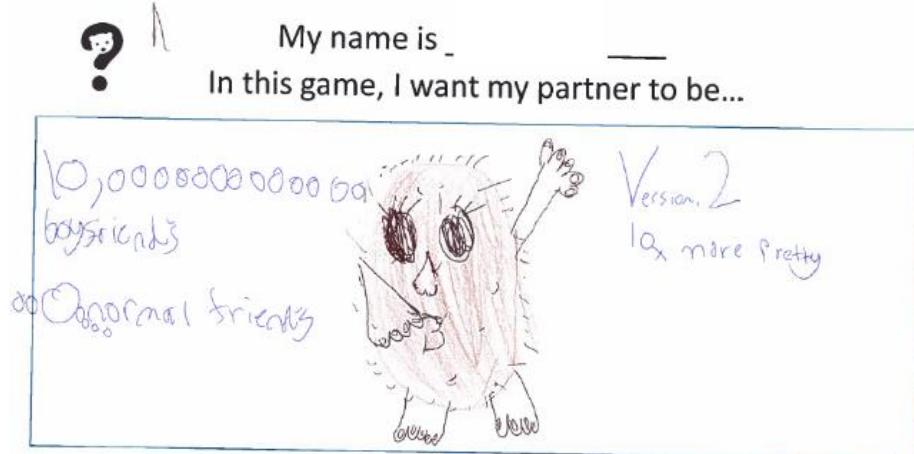
My name is _____
In this game, I want my partner to be...

My partner's name will be: Madam Idiot

Figure 6. Drawings of a) Madam Idiot and b) Fake Pikachu.

With the ability to eat anybody for making a mistake, Madam Idiot partnered with fake Pikachu. They were bathing in a volcano, when it started shaking and they jumped out. After that, they encountered a monster in a forest and killed it with a dagger.

Polly the Potato and D.J Gopher



My partner's name will be: Polly the Potato

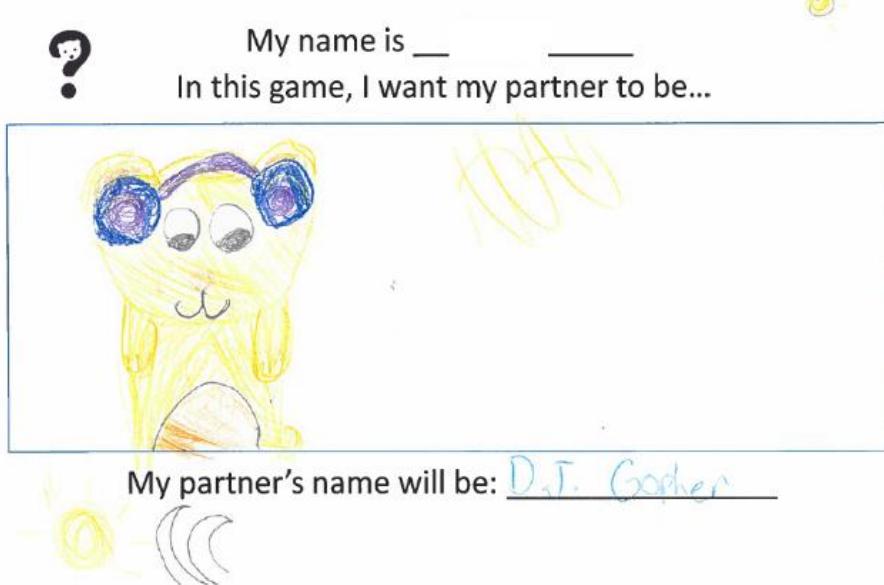


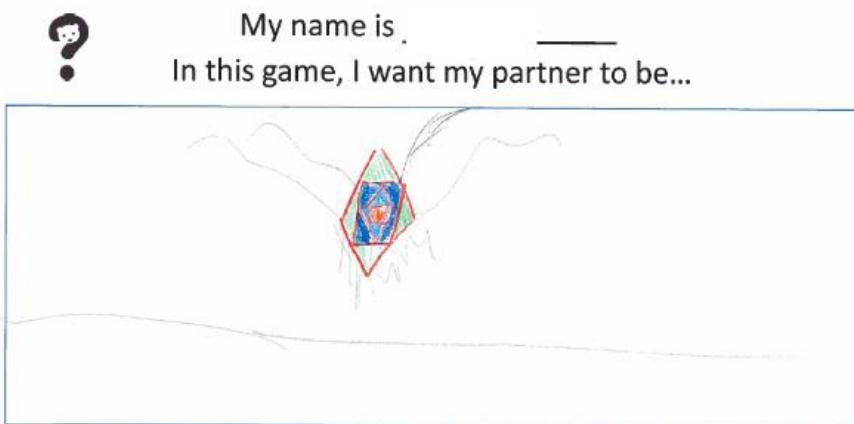
Figure 7. Drawings of Polly the Potato and D.J. Gopher.

Polly the Potato is the best potato, with arms and legs. She has 10,000,000,000,000 boyfriends and 10,000,000 friends. D.J Gopher is a gopher with the ability to listen and play any music. The children who came up with these two partners were distracted and could not agree on a story.

Numbers and Zero



My partner's name will be: numbers _____



My partner's name will be: Zero _____

Figure 8. Drawings of a) numbers and b) Zero.

Numbers is an entity that could count from 1 to 45 but no more because it was damaged during its adventures. Zero is a computer chip like object that taps into computers to absorb what it knows and moves by hovering and has tentacles.

Zero crash landed on a ship, tapped into a super computer and obtained what it knew along with its virus and, to escape, had to find Numbers. At the same time, Numbers crashes into an asteroid and lands in a jungle. Zero finds him there and he fixes Numbers. Together they go to Earth, hack into the Largest Supercomputer and download all the knowledge in the world.

4.15 Discussion

The partners created came from aspects that the child were familiar with or had some investment in. Drenched Sock, the guinea pig, was made because the child owned guinea pigs. Most of the partners bar one, Clare, were non-human. This suggests non-human teachable agents would be more appealing to TD children.

A more important conclusion came from the off-hand comments from one of the children, who complained after explanation of the scenario-based game design that the workshop was too much like school. This implied that no matter how this iteration of the game was designed and rewarded, with points or animations, the core gameplay would not be engaging. Therefore, the decision was made to scrap the scenario-based game and come up with a new way of engagement.

4.2 Expert evaluation

Taking inspiration from the children's characters working together to accomplish a goal, a new game was designed where players would have to use a 'travel machine' to help Polly the owl find the player's Grandpa, who used the machine earlier. As they use the machine and travel to various locations, such as the park and the zoo, they meet characters who are location specific and have knowledge about where Grandpa is. These characters, having been asked by Grandpa to quiz Polly and his Grandchild on aspects of past tense, tell them the next place where Grandpa went using the travel machine. When the game was finished, players could then play story-related minigames as rewards, such as helping the Park Ranger, a character the players were to meet, pick up rubbish and put it in a bin. This idea would be replaced by rewarding players with sub-plots that broaden the narrative after the interviews.

4.21 Aim

A pen-and-paper prototype with screenshots of 3 short scenarios in the game was created, where players visited a park, a zoo, and found Grandpa visiting a volcano. This prototype was presented to several expert evaluators, E1 to E3, for advice and feedback. E4 played a more advanced prototype on a laptop, which had the addition of a train station and in space. The interviews revolved the following questions.

1. How appealing would a computer-animated agent like Polly the Owl be to children with Autism?

2. What kind of mini-games are a viable reward for the game?
3. Is a repetitive narrative structure, where players visit an area, talk to a character, answer their question, and move to the next location, too boring?
4. Is there a way to prevent players from just skipping the text without reading?

4.22 Participants

Experts were chosen based on different specialisations ranging from Human-Computer Interaction to Education and education using games. 4 participants took part.

Participants	Background
E1	Retired lecturer in digital education who has a background in Educational Psychology with a lot of research in applying game concepts and structures to learning and education. Has a grandson who has autism.
E2	Holds a Masters in Artificial Intelligence, specializes in educational technology for autism, and has worked as a user-experience researcher.
E3	PhD student with a specialization in human factors. Has experience on similar projects like this one. Not a specialist of people with Autism.
E4	A lecturer in Adaptive Learning Environments with a specialisation in supporting learning and communication in children with special needs through technology and game-like environments.

Table 2: Participants of the expert interview

4.3 Interview structure

The participants were contacted directly through email and interviews conducted throughout the buildings of the University of Edinburgh campus. The game idea and purposes of the interview were explained to participants. Participants were then asked to give verbal consent in taking part, being recorded, and having notes taken by the researcher. The interviews were semi-structured: The goal of the application, the narrative story revolving around finding Grandpa, and the use of multiple choice questions to learn past tense were all explained. Questions revolved around the use of backgrounds, the level of language to use, the types of rewards, and the use of a repetitive story structure. From there, different observations were made and follow up questions were asked. This continued for around 30 minutes for each participant. A follow-up email of thanks was sent after the end of each interview.

4.4 Results

The game structure

All participants had no issue with the structure of the game, which was linear in nature with a strong emphasis on narrative. However, E1 encouraged deeper thinking on giving a narrative reason as to why the people the players encounter are ‘so unhelpful’ when meeting the player, demanding that they answer a question before they tell them where Grandpa is. A reply that Grandpa had asked these people to quiz the player, with the implication that Grandpa is a fun man, was met with positive reception and that they could accept that as a reason. E4 thought that the goal of the game, having players pick up regular past tense, was not obvious when playing it.

Reward systems

When told about the minigame system that was to be implemented, E2 suggested that they could either be implemented during the game or at the end. However, they also suggested making finding Grandpa at the end more rewarding. This ties into what E1 said, who noted that the game was more like an interactive storybook and that the minigames would make the narrative more game like. However, they warned about the possibility that the minigames could be distracting, and that from a design point of view, sub narratives might be worth exploring as a reward instead of minigames. Against the above, E3 struggled to see the engagement without minigames and recommended that they be included. The decision was made to create a short sub-plot as a reward for completing the main story.

The use of backgrounds

The backgrounds chosen when interviewing E1 and E2 were cartoon like and not realistic. There were no issues with the chosen backgrounds, but E1 encouraged thinking about why Grandpa was moving through these places in the first place, tying into the sub narrative reward system explained above. However, after realizing there were issues with copyright, stock photos found on various websites were utilized instead. Since these photos were all realistic, E3 was asked whether they were appropriate for the target age range. In response, E3 said that while it would be good if the backgrounds were a bit more cartoonish, the realistic backgrounds were acceptable.

Language learning and repetitiveness

After bringing up the worry of repetitiveness in story structure, E1 commented that it might be a good thing and can be seen as a design choice. E2 commented that the intended audience may associate ‘ed’

endings with the correct answer but may not link that with the concept of using ‘ed’ words to describe events that happened in the past. They suggested making two lists linking -ed words with yesterday as a tutorial for children.

However, fearing that this would again make the game too school like, an alternative was implemented in the final game. A couple of stages were included in the updated prototype. In the first stage, players had to pick the ‘ed’ word that describes an event that occurred yesterday; in the second stage, players had to pick an entire sentence that describes a past event. E3 did not have specific expertise in this area and did not comment.

Finally, E4 thought the Station Master’s speech was too quirky and that their speaking patterns were not good for the children. Some parts of the dialogue, such as when the Station Master bumps into Polly the Owl, was not clear.

Gaming the game

Explaining the worry that players might just skip through the game without reading the text, both E1 and E2 suggested a wait time be implemented before being able to tap to proceed with the game. E2 commented that if possible, the game could implement shorter wait times for shorter text and longer wait times for longer text.

E1 said that there would always be ways of gaming the systems but suggested that a short wait time of 1-2 seconds could be implemented to discourage rapid progression. After consideration, no wait time was implemented so as not to constrain the player’s choice to skip aspects of the narrative if so desired. This was desirable rather than the player quitting completely. When told of my decision, E3 suggested that while strict enforcing of a timer was not necessary, the game could limit the locations where the players could click to progress in the game, such as having the players click on the dialogue box or on a button to progress.

Virtual agent: Polly the owl

When players pick the wrong answer, the character asking the question, such as the park ranger, will explain what went wrong. E2 noted that Polly, as a virtual agent, could take over this role as it was their role to guide the player through difficult areas of the game. This was implemented in the final version of the game.

Portraiture and UI

E3 mentioned that while the portraiture and UI of the game was serviceable, it could benefit from a menu that would allow the player to edit options such as sound, a ‘help’ button that can give an overview of what to do, and give the player the option to quit.

4.5 Summary

Because of feedback from the design workshop as the game sounding too much like school, the game concept evolved from a scenario-based game with different stories as contextual settings to a narrative game with a strong emphasis on story and characters. The decision to make Polly the owl a virtual agent stemmed from the children’s various drawings on various non-human partners who had special traits. A short 3 stage scenario was created and screenshots presented to several experts in order to improve the application as a useful learning tool.

The feedback from these experts concerned several aspects of the game, such as rewards and how language can be conveyed. These were all conceived with the thought of emphasizing the narrative aspects of the game. As such, a sub-plot was implemented that could be accessed after completion of the main game. Modifications to the multiple choice questions were made in order to encourage links between morphology and pragmatics of the use of ‘ed’ words. Wait time was not implemented as this gave the children who were bored the option to skip through areas they did not feel engaged with, although players were limited to clicking on the dialogue box. A menu was implemented to allow players to save, load, and quit the game when necessary. In the final game, a ‘help’ button would be implemented to tell the player about the game and what to do.

Chapter 5: Final prototype

While a mouse and keyboard interface is suitable for the final prototype, it was developed for a tablet with touchscreen capabilities. The game was made using Unity 5, particularly using Fungus, a free asset toolkit built for easy construction of 2D and 3D games, made and maintained by Snozbot. Fungus simplifies game creation by reducing the need to program in C#, Unity's programming language, and uses flowcharts for the creation and maintenance of narrative and dialogue. Fungus is created by Snozbot. While the game is described below, a full storyboard of the game with screenshots is presented in the appendix G.

The overarching story about finding Grandpa was kept in the game. Based on E1's comments to exploit the game's capacity as an interactive story, a new sub-section called 'Grandpa's Story' was added. When the game is first started, the players are taken to a screen with the options 'Play Main story', 'Play Grandpa's Story' and 'Quit'. 'Play Grandpa's Story' is supposed to be unclickable before finishing the main story, but this could not be implemented in the final game. Thus, the only option available would be to 'Play Main Story'.



Figure 9. The Main Menu screen for the game.

Players are then greeted by Polly the Owl. As Polly's gender is never described, this paper uses the pronoun 'her' to refer to Polly. Polly is a little anxious as Grandpa has used a travel machine and has Polly wants help to find him. The player is then given a choice to help Polly or not. If they choose not to, Polly confirms the decision by asking the player again and says that she could use their help. If the player chooses no again, the game quits.

If the player accepts, the scene changes to a zoo. After some dialogue, the zookeeper shows up and says that they know where Grandpa is, but Polly and the player must answer a question to know where he is.

Once they answer it, this cycle repeats 3 more times in a park, a train station, and in space, before finding Grandpa at a volcano. The locations of the zoo, park, and train station were based on findings in design workshops reported by Wudhiphan (2018) where such locations were preferred by children. Space was chosen as a surprising contrast for the players and the Volcano was chosen based on the findings of the design workshop with children.

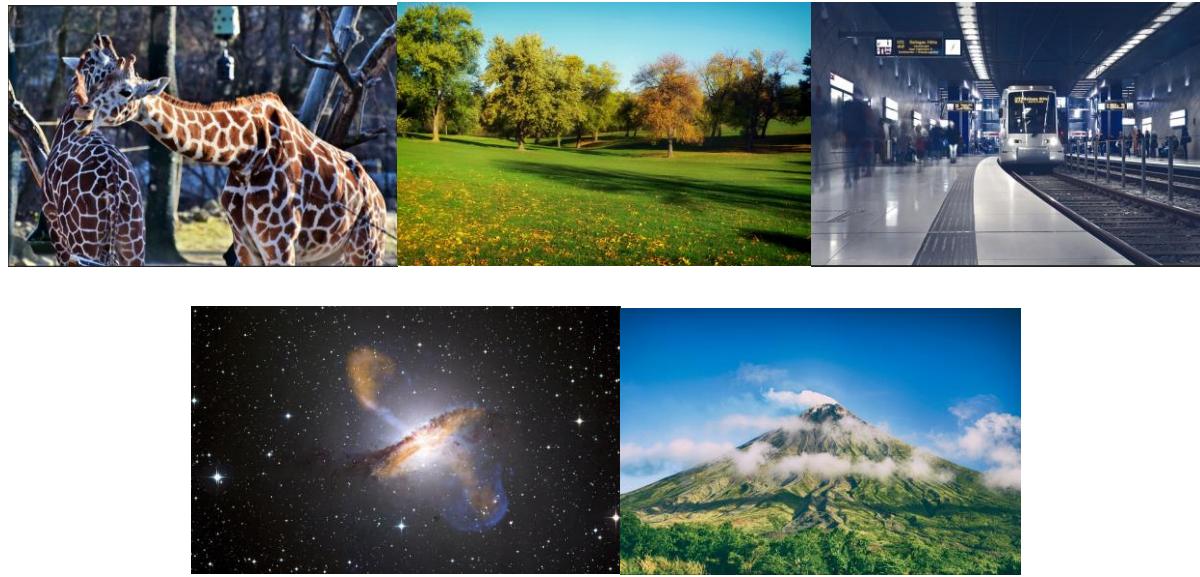


Figure 10. These backgrounds, from left to right and top to bottom, represent the locations that the player visits with Polly.

Based on E2's comments that children with Autism have difficulty linking 'ed' words to the past, the game's question type changes and increases in difficulty as the game continues. The first two scenes in the zoo and the park have players choosing words that describe what the character asking the question did. The last 2 scenes in the train station and in space have players choose sentences that describe what Polly or the character asking the question could have done in the past. After each question, a short animation relating to the question's content is played out, ranging from a milk carton tilting left to right to a little blue stick figure 'running' from left to right.

As choice is important for children with Autism (Carter, 2001), there were two points where players could interact with Polly. In the zoo, Polly asks the player what animal they like, and in the train station, players can choose whether they like trains or not. Polly has a unique response to each option. To keep from boredom with the narrative (Lebowitz & Klug, 2011), an unexpected twist was added after the player visits the train station. After being told that Grandpa is visiting a volcano, Polly and the player are transported

to space, intercepted by an alien that has been observing them and wants their help in understanding English.

After the game is finished, players can choose to play Grandpa's story. Players play as Grandpa in first-person mode before he decides to use the travel machine to visit his friends. It gives context as to why Polly needs the player's help to find Grandpa and gives character to Grandpa as a cheeky, fun person who likes to test his grandchild from time to time. There are no choices to be made during this sub-plot. This sub-plot lasts until Grandpa leaves the zoo, after which the game ends and the player is thanked for playing. Grandpa's Story is presented in appendix H.

Chapter 6: Evaluation feedback from children and experts on the final prototype

Like in chapter 4, workshops with TD children and interviews with experts were conducted to obtain feedback regarding the game.

6.1 Workshop with TD Children/Method of feedback

As before, access to children with Autism was not available, so the evaluation workshops were run with TD children just like in the design workshops. Their ages ranged from 6 years to 11. Given this wide range, the younger children were observed as they played the game and questions were asked at the end. The older children gave feedback as they played the game and questions were asked based on specific feedback.

6.11 Aims

Putting aside bugs, the overall goal was for the children to provide feedback regarding the following areas of the game:

1. Can the children follow the narrative?
2. Are the questions asked too difficult?
3. Did the overall graphical design of the game, consisting of animations, sprites, and backgrounds, feel engaging? Similarly, was the minimal inclusion of sound adequate?
4. Further areas for improvement.

6.12 Game platform and materials used

The game was played on the laptop, not an iPad as originally intended. This meant that the children used a mouse to point and click to advance the story. A mobile phone was used for recording and paper and pen used for taking notes.

6.13 Participants

7 children participated in this workshop. As mentioned, the children's age ranged from 6 to 11 years. The children were divided between 2 workshops, with 5 in the first and 2 in the second and each child played the game for 25 minutes and gave feedback in the last 5 minutes. Not all participants managed to finish the game, and fewer still completed the side story 'Grandpa's story'. Many of the children had previously participated in similar workshops and were thus very experienced in such game testing.

Participant	Gender	Age
P2*	Male	9
P3*	Male	9
P9	Female	6
P10	Female	8
P11	Male	6
P12	Male	11
P13	Male	9

Table 3: Participants of the evaluation workshops. Starred participants (*) means they participated in the previous design workshop

6.14 Setting

The 2 workshops took place in a spacious room in the University of Edinburgh Informatics building.

6.15 Procedure

All participants signed a consent form (See Appendix C) regardless of previous participation to participate in the workshops. The children were also asked before starting the game whether they wished to participate and their verbal permission was received to record them audially. None of the children chose not to participate, though there were varying levels of engagement.

The laptop was set up with the main screen of the game loaded up as shown in figure 9. The children were briefed on how to play the game, with a brief tutorial on how to use the mouse for younger children. After clicking on 'Play Main Story', the children were briefed on the controls of the game, asking them to click on the dialogue box to proceed. The dialogue was read out loud for children unless they stated a vocal preference to read it by themselves. Less guidance was given from this point on unless there were bugs or they asked for help. Exceptions were made for one child, P11, who showed little interest in the game but could be encouraged by the presence and play from the researcher and supervisor.

If players completed the main story and there was time left, players played through Grandpa's Story. Again, the dialogue was read out loud unless they indicated a desire to read it by themselves. Observations and notes were written by the researcher during gameplay. After 25 minutes, the children were asked questions for their feedback. A think-aloud protocol was taken with P12, who was very experienced with these kinds of workshops and gave good feedback along the way. More specific questions were asked regarding the difficulty of the questions.

6.16 Results

Narrative

All the children regardless of age found that they could follow the overall narrative and understood that they were trying to find Grandpa. They could also understand the underlying logic of each scenario, meeting someone, having to answer a question, and the reward of being told where Grandpa went to. P3 enjoyed the surprise transition of going to space without warning, while P9's and P10's favourite part was finding Grandpa.

However, a major point that they found difficult was realising that the silent protagonist the player plays as is different from Polly the Owl. P9 expressed surprise when Grandpa said that 'you will grow up to be a very smart person', suggesting that they thought Polly was the grandchild of Grandpa. One of P12's suggestions was that older children might find it weird that the grandchild is a different species from Grandpa, but younger children might find it acceptable. This showed that the children could not tell that you were playing as 'you' rather than as Polly the owl. This was confirmed in the next workshop with P3 and P4, who, despite being older, had to clarify with the researcher who they were playing as shortly into the game. This point will be emphasised in the expert review, described in the next section.

There was a minor point where, when children could choose which animals they liked, P12 noted that turtles were not commonly seen as wise. This is most likely because of a cultural difference between the researcher and the children, coming from a Chinese and English background respectively (Wang & Cui, 2015). While this point is acceptable for a prototype, the final game would require more rigorous research on associations with animal words to make it suitable for speakers from that particular region, in this case, the United Kingdom.

One participant, P11, who was within the lower bounds of the target age range, was very disengaged. However, they managed to finish the game with the researcher and supervisor talking to him and pointing out aspects that were exciting, such as asking whether or not they liked trains. When asked if he liked

reading, P11 expressed disinterest. This dislike for reading is likely to correlate with a dislike for this game because of the heavy storytelling nature of the game. However, this could possibly be transformed into a learning opportunity if the teacher can interact one-to-one with the disengaged student. Alternatively, if the student is to use this game alone, additions such as voiceovers and background music can be used. These are discussed below in ‘Graphical and Aural design of the game’.

The children were interested in playing Grandpa’s Story after the main story. However, players did not enjoy this sub-plot as much as the main storyline as there was no interactivity involved. This shows that even in the rewarding sub-stories, some minor plot branching should be done to give the players the illusion of making choices, even though the outcome is the same. The sub-narrative itself was not as well-received as players such as P2 did not enjoy ‘how Polly was on Grandpa’s side and did not tell you’ during the main storyline. However, P3 was curious about one line in Grandpa’s story, where ‘...Papa and Mama went on a business trip’ and wanted to know more about Papa and Mama’s role in the story. Sub-plots appear to be an appropriate reward and they can be tied into the main protagonist, in this case, the Grandchild. However, one must be careful when crafting more complex storylines that may annoy players, as happened in this case, or confuse them.

Question difficulty and linguistic content

As described in chapter 5, the game has increasingly difficult questions. It soon became clear that the game was too difficult for children aged 5-10. P9 and P10 had to guess for all of the questions. P9 could answer question 3 and said it was ‘easier’, though she could not mention why. It is possible that having the text read out loud made it easier for her to engage in the explicit grammar teachings regarding the presence of ‘ed’ in past tense words. P10 chose the options that were focused on the present as they were happening now. This could be because she insisted on reading the text herself and was thus focused more on reading more than the narrative and could focus less on the grammar. P3 noted that the word ‘cleaned’ being highlighted in green helped in answering the first question, indicating that it fulfilled its function as a scaffold for the player.

P3, P4, P12, and P13 despite being older, all expressed that the game ranged from average difficulty to difficult. All of them showed hesitancy in answering the train station question and had to rationally guess in the alien question by eliminating choices that were impossible. However, P12 appreciated the idea of the questions becoming more difficult, instead of being of static difficulty, commenting that it would allow more people to play it.

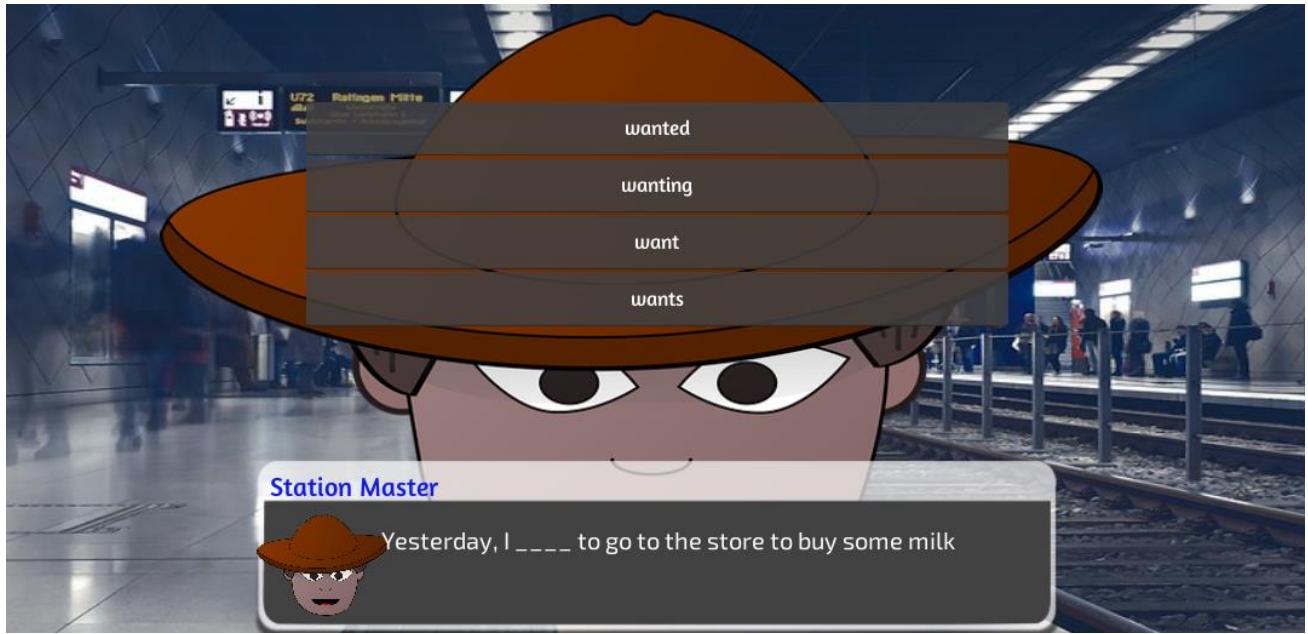


Figure 11. The questions at the a) train station and B) in space are more difficult than the first 2 questions.

The questions would have to be simplified, perhaps giving 2 choices instead of 3, and comparing the regular past tense with the simple present tense for an easier contrast. More progressive elements of grammar can be slowly introduced as the game progresses.

Graphical and Aural design of the game

Aurally, the beeping sounds that the Fungus engine provides to indicate dialogue being spoken was a negative aspect of the game. P3 explicitly mentioned the beeping as an aspect he did not like and would have preferred voiceovers. This fits in with how most VNs include voiceovers for anyone who is not the player character. However, an option should be included to disable voiceovers for two reasons. First, some children, such as P10, preferred to read the dialogue on their own. Second, this option allows teachers to place more emphasis on reading comprehension without assistance from sound.

Turning now to the graphical aspects and addressing the places players visited first, players enjoyed the first four scenarios of the zoo, park, train station, and space. Opinions were divided with respect to the final scenario, the volcano. P9, at age 6, described Grandpa going to the volcano as one of the aspects she did not enjoy, because 'it was scary'. However, she said she could play through the scenario because she knew it was not a real volcano. P12 suggested that the zoo could be a petting zoo instead, to allow for more common animals like dogs and cats to be selected among the animals that they like. P12 also suggested more backgrounds related to a particular scene, such as different animals or enclosures in the background of the zoo, to make it seem like the characters were walking and talking.

The rewarding animations received neutral to positive reception. P12 suggested that while the animations were serviceable, certain adjustments can be made, such as slowing down the 'running man' that moves from left to right after the park ranger's question. P3 seemed to be amused by the animations, while P13 thought they could be distracting for certain people. P9 and P10, although younger, did not react to the animations at all.

The sprites used were positively received. Polly was especially well received, with comments such as how her eyes were very big, making her look cute. In the final game, professionally drawn and animated sprites would be used to represent characters and these workshops reinforce the idea that a more cartoonish look is more appropriate for children. There was some contention about how the sprites 'revealed' themselves suddenly without animation. While the younger participants were neither positively nor negatively affected, P2 did have some starts and scares despite being exposed to VNs before. This could have been exaggerated, and he mentioned that he enjoyed the horror genre and thus enjoy being scared. Aside from P2, P12 said that Polly came in too suddenly and that an animation, such as Polly 'expanding' to make it look like she's coming forward, could be used.

6.17 Summary of the workshops

3 different areas, narrative, linguistic content, and graphical and aural design were explored during the workshops with TD children. Both younger and older children seemed to enjoy the game's narrative structure. However, the linguistic content was too difficult for children of any age. Graphical and aural design seemed to have more of an effect on the older children, but this could be because the younger children were unsure how to provide feedback. The VN as a game medium seems most appropriate for children who enjoy reading and extremely boring to children who dislike reading. However, with a few modifications, this game type can be used as a short game to introduce the concept of regular past tense to children.

6.2 Expert interviews to evaluate the game

3 experts were consulted to evaluate the final prototype. Like in the design stage, these experts have a diverse range of backgrounds and could give feedback based on their relevant expertise. This feedback served to reinforce points that were explored in the workshops with TD children and cover more areas that might have been missed out during those workshops.

6.21 Aims

The particular aims of these interviews were to ascertain the following:

1. Is the narrative appropriate for children with Autism?
2. Are the in-game questions appropriate?
3. Are the graphical and aural design of the final prototype appropriate?

6.22 Game platform and materials used

As in the workshops, the game was played on a laptop, not an iPad. This meant that the experts had to use a mouse to interface with the game. A mobile phone was used as the recording device and paper and pens were used to take notes.

6.23 Participants

The 3 experts who participated are presented in the table below. One of the experts, E1, had previously participated in the design workshop discussed in chapter 4.

Participants	Background
E1*	Retired lecturer in digital education who has a background in Educational Psychology with a lot of research in applying game concepts and structures to learning and education. Has a grandson who has autism.
E5	Research associate with specialisations in Human-Computer Interaction, Digital Learning, Game Design, Assistive technologies, Educational technology, and technology for Autism.
E6	PhD student in Human-Computer Interaction, with a specialisation in technology for children.

Table 4: Participants of the expert interviews. Starred participants (*) means they participated in the previous expert interviews.

6.24 Setting

The interviews took place in quiet rooms in various buildings belonging to the University of Edinburgh.

6.25 Procedure

E1 and E5 were emailed about the game and asked if they could participate as an expert. E6 was present during the above-mentioned workshop for children and participated in the interview between workshops. All interviewees were asked if they could be recorded and told that they could withdraw at any time. After verbal consent was given, the experts were directed to the main menu of the game and informed about the relationship between the main story and Grandpa's story. Experts then chose 'Play Main Story'. After completing the main story, E4 and E5 played Grandpa's Story; E6 was given a quick demonstration and explanation of the plot. While a think-aloud approach was encouraged, E1 decided to give feedback only at the end, as he was focusing on the narrative. Interviews ranged between 30 minutes to 1 hour.

6.26 Results

Narrative's appropriateness

The overall narrative was understandable as being somebody that was trying to find Grandpa. As with the children's workshops, it was not clear who exactly was trying to find Grandpa as Polly was the one doing all the talking and 'you' were not present in the scene at all nor had any speaking lines. This difficulty was compounded by the 3-way conversation, where E1 and E5 mentioned that it was not clear when Polly was being spoken to and when the player was being spoken to. E5 went as far as to say it was not clear whose Grandpa it is players were looking for.

All 3 experts suggested the introduction of an on-screen avatar to represent 'you', meaning the player, as the Grandchild alongside an 'input your name system' so that players know who they are. This will also make it clearer who each character is talking to, with it being clear that they are referring to 'you' by name. E5 emphasised that the children with Autism would be more like the younger TD children in the workshops, and thus do not have the cognitive ability to understand the complexity of a 3-way conversation. E5 even suggested removing Polly altogether and simply have the conversations take place between the Grandchild and the other characters in the game.

There is a point in the story where Polly interrupts the Station Master by finishing their sentence. While the intention was to 'read' the player's mind and allow them to express frustration through Polly's words, E5 said that this interruption could impart rude teachings. This interruption would implicitly teach the rule 'it is appropriate to interrupt people and finish their sentences'. Therefore, such rhetorical devices should be removed from the game.

After playing Grandpa's story, E4 thought that the difficulty of the story should depend on the age of competency of the players. E4 also thought that the idea of a prequel could be confusing for children as it relies on tropes that we as adults are familiar with in literature. E5 thought that playing as Grandpa without warning was confusing. A dialogue box or a clickable 'help' sign that told players that they were now Grandpa could be useful. Sub-plots such as Grandpa's story seem viable but must be made more digestible by children.

The presentation of the stories was contentious. The main menu showed 'Play Main Story' and 'Play Grandpa's Story'. E1 suggested that the words 'play' be replaced with 'read' because 'play' might set up expectations of gameplay that is like what children are familiar with in other games. Given that the Visual Novel is still relatively unknown outside of Japan, this might be warranted. E5 suggested that the main

story be renamed to 'Play Grandchild's Story' to make it thematically consistent with 'Play Grandpa's Story'.

One final point was the use of 'Grandpa' by all characters to refer to Grandpa the character. E1 thought this was unobjectionable, given that 'Grandpa' was being used as an honorific. However, E5 suggested that they refer to Grandpa by their real name, since he is not their grandfather, only the Grandson's, and that it was rude to call someone who was not your grandfather 'Grandpa'. Future iterations could give Grandpa a name, such as 'Max', that other characters can use to refer to him.

In-game questions and linguistic content

E6 liked the progression in question difficulty and said that there was scope for the questions to be split into separate games or placed across different sub-plots. However, just like in the workshop for TD children, the questions were deemed too difficult. While instructions on what to do were given on the dialogue box before the question, E5 thought this was not enough for children with Autism as they will have a lot of items to mentally process. Such items included learning the past tense, knowing what to do, and reading the question.



Figure 12. Screenshots from the game where a) Instructions were given before the question popped up, but b) during the question itself it was not clear what players were supposed to do.

E5 also thought that the content overloaded the student. Some of the questions demanded too much from the student, such as the first question relying on students understanding the present continuous and simple future tense to contrast with the past tense.

While the above issue can be addressed with some tweaks to the program, a more serious issue arose concerning the explanation of grammatical rules. An explanation used was that Polly knew that the answer to the first question was correct because of 'ed' at the end of the word. This was tempered in the

next dialogue box telling the player and Polly to be careful because some past tense words did not end in 'ed'. E5 pointed out that while this is technically true, it missed out explaining words that end in 'ed' but are not past tense words. An example given was 'bed'. E5 cautioned that children with Autism take rules very literally and will, once reading the rule, think that every word that ends with 'ed' is a past tense word.



Figure 13. These screenshots show the explanation of the grammatical rules of regular past tense words. The cleaning equipment at the top right is part of the rewarding animation for answering the question correctly.

Finally, although the game was a good framework for future teachers, E5 recommended consulting a grammar teaching book to see how regular past tense could be taught progressively.

Graphical and aural design

Aurally, the beeping sounds that indicate dialogue was negatively received. While E1 and E6 had no issues with it, E5 said that this sound may not be good for children with Autism and may annoy them. An option to disable it should be provided in the final game. Voice actors or Text-to-Speech capabilities to read the dialogue would be better than the beeping sound.

Graphically, E1 and E6 would have appreciated more backgrounds to simulate walking between scenes, echoing P12's suggestion in the workshops. E1 said the animation rewards provided seemed cartoonlike and out of place with the realistic background. E1 also mentioned that more reassurance that all the player had to do was click in the dialogue box would be welcome.

E5 found the positioning of dialogue and answer boxes unintuitive. Paying attention to the dialogue box, E5 sometimes did not know that players were supposed to pick an option rather than click on the box to continue. To fix this, the dialogue box could be placed at the top of the screen and the answer boxes below them, to replicate how students may answer a question on a sheet of paper. E5 would also remove the background sprite while the question was answered to remove distractions. Extending this though, E5 thought that the use of sprites twice, once in the background and once in the dialogue box, unnecessary. Instead, have sprites speak with a text bubble that showed who was speaking. This is related to the point under "Narrative's appropriateness" where an avatar was recommended for the player character to identify with.

Finally, E5 suggested that the text colour match the colour of the character's name. For example, Polly's name appears in light blue, so the text of the dialogue she says should be in light blue too.

6.27 Summary of the interviews

Once again, looking at the Narrative, linguistic content, and graphical and aural design of the game, the Visual Novel seems to work as a good framework to teach grammatical content such as regular past tense. However, future work must be careful to look at grammatical content that is simple enough for children. A reduction in the number of characters is also appropriate to simplify dialogue and make it clear who is talking and who is being addressed.

Other points include using an on-screen avatar and having a name input in the final game. Sub-plots to a Visual Novel should be age specific and the game could be presented differently as 'reading' rather than 'playing'. Finally, the position of dialogue boxes makes a big difference in engagement and, using a genre that is not as popular, makes a difference in introducing VNs to children with Autism.

Chapter 7: Discussion and Conclusion

This chapter first answers the research questions presented in the beginning of the paper in light of the findings from the workshops. It then discusses future work that can be done.

7.1 Answering the research questions

This paper aimed to answer three questions, shown again below.

1. What type of game would be best to teach regular past tense verbs?
2. How can the game be designed such that it can be fun and engaging for the target group?
3. Are Visual Novels viable as an educational game?

Initially, a literature review was conducted to answer the questions in a preliminary way. This review suggested that role-playing games were the best way to teach regular past tense verbs and that Visual Novels (VN) were a good medium to teach this. The initial idea was to teach regular past tense through scenarios that would somehow interlink together, with a virtual character following the player based on Bosseler & Massaro (2003).

Based on the design workshops with TD children, this idea did not seem viable and was deemed too much ‘like school’. However, most of the stories the children came up with included characters working together to accomplish a goal. Therefore, a new narrative based on finding Grandpa was created. Expert interviews were conducted to get feedback on paper prototypes and initial ideas on how the game would be designed. This led to the incorporation of sub-plots as a reward for completing the main story, along with the decision to restrict progression by pressing on the dialogue box instead of the entire screen.

The final prototype was assessed by TD children and experts. The use of VNs, while unusual outside of Japan, showed promise as it engaged children from ages 6 to 11. The use of sub-plots were also promising as players were interested in the expanded narrative of the game from Grandpa’s point of view and answers question 2. However, it is unclear whether VNs are appropriate for teaching regular past tense verbs, since the final prototype was deemed too difficult by everybody. Yet, it is still a good framework and thus the genre shows promise in being a competitive alternative to other educational tools when properly built, answering question 3.

7.2 Future work

There were a few suggestions made that would further improve the game. As these suggestions have been explored in chapter 6, this section summarises the themes, simplification and representation, that bind them together.

Simplification: While the overall narrative of finding Grandpa is not complicated, the dialogue structure used was too complicated. While Polly the Owl was introduced as a partner for the player, players had trouble distinguishing between the player and Polly, especially since the player did not have a sprite in game. Removing Polly from the game and keeping dialogue between the main character, the Grandchild, and other characters would clarify interaction for players.

Representation: While most VNs do not show the main character during play, showing a sprite of the main character in game will help players quickly identify who they are playing as. Allowing players to input their name into the game would also clarify when characters are talking to the player.

After changes have been made, two types of studies can be run. First, A study to see if VNs are viable as a game genre that engages children with Autism and can be used without supervision. Second, a study where the game is used in classrooms or in one-to-one scenarios where teachers use the game as part of their curriculum. These studies will further inform how VNs can be adapted into an educational tool through their narrative, graphical, and aural design.

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Appendix A: Information sheet for parents and guardians

Designing Educational Apps for Children/ Learning basic living skills

Information sheet for parents and guardians

This information sheet is for parents and guardians; it explains 4 research projects at the University of Edinburgh, in which we would like your child to participate. It gives information about the projects in the form of questions you might have and their answers. If you have further questions, we are happy to discuss them and give you more information.

The researchers on this project and their contact details are as follows:

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Please return the parent consent form to one of the researchers

Overview of the projects

Yan's project aims to explore children's behaviors to cope with normal social situations and guide children to deal with social scenes in the right way. Nemo's project aims to create a game that teaches past tense verbs to children. Zhao's project explores the way to teach children learn and obey the rules to cross the street. Amrita's project aims to develop a game that helps children practice having reciprocal, conversational interactions with the use of imaginative game-play.

What are the goals of the projects?

Yan's project aims to guide children to correctly understand and respond to social situations they may encounter in their lives, thus helping children to better integrate into the social environment.

Zhao's project focus on crossing the road which is a common but important thing in children's daily life. Learn the rules and ignore the bad behaviours of the other pedestrians are the key points to guarantee the safe for children. The project explores the way to teach children learn and obey the rules to cross the street.

Regular and Irregular past tense verbs can be difficult for some children to learn. Nemo's project aims to create a game that teaches past tense verbs to children.

Amrita's project aims to develop a game that helps children practice having reciprocal, conversational interactions with the use of imaginative game-play.

What is the purpose of the workshops?

Yan's workshop will help us to understand the social difficulties that children may encounter in their daily life and how children will deal with specific social situations.

Nemo's workshop will help in creating a story through which children learn the past tense. We aim to explore minigames and other potential rewards that can be given, create a teachable agent as a partner that accompanies the player, and explore what verbs children think may be difficult for others to learn.

Amrita wants to look at how children talk to one another and she wants to find out more about the "rules" of conversation to integrate into her role-playing game. These rules will be turned into obstacles courses and mini in-game goals. Besides that, she'll be exploring plotlines, potentials characters and game interface options for her game.

Zhao wants to collect the information for the game design. We are aimed to know the extent of children's understandings of the rules. Children's suggestion for the characters, rules and rewards in the game.

How can my child help?

Yan's workshop is used to investigate the specific situations that children would have interactive with others. These will be achieved through multiple choice questions, single choice questions, conversations, paintings, etc. Helping children have a better social intercourse with others by understanding the problems children would meet in their daily life.

In the Nemo's workshop, children may draw or storyboard a story, draw and name a partner for their story, write out rewards they find captivating, and write down verbs they think will be hard to learn.

For Amrita's workshop, she'll have the children guide her through what they believe are the right ways to have a two-way conversation (i.e. letting the other finish talking, being attentive, etc.). This will be followed by the children going through the quest themselves and coming up with new obstacles, goals and characters that have something to do with the rules of conversation.

For Zhao's workshop, she is aimed to know the extent of children's understandings of the rules. Children will write down the rules about crossing the street they know and point the bad behaviours in some pictures. Some suggestions may ask for the game about character, rules and rewards.

Workshops Information

What happens during the workshops?

We will always spend some time before the workshop sessions to talk to the children, in order to get to know them better and allow them to get to know us, with the aim to make them more comfortable. Your child will get to participate in design workshops, brainstorm ideas about emotions and friendships, participate in group discussions, create drawings and test prototypes of the app for c 40 minutes for each workshop, or until they want to stop (whichever is first).

Video recordings

We would like to either video or audio record the session, to provide a record for later analysis and allow us to freely interact with your child during the session without worrying about taking notes. If you prefer that we do not use videos or pictures of your child for publications, presentations or teaching purposes, you can indicate this on the permission form. In that case, the video would be seen only by us during the analysis. If you are not comfortable with your child being audio (and possibly video) recorded at all, then your child should not participate in this particular study.

Additional Study Information

Will this project teach my child new skills?

This project is not a type of therapy or intervention. We will not be teaching children new skills or improving existing skills. We are rather interested in your child's current knowledge and awareness regarding emotions and regulation strategies, friendship and interpretation of art. The information we learn from this project may be used in future games/websites that could help children, or to improve our understanding of children's art appreciation.

What happens when the project is over?

After the study has finished and we have analysed the information we collected, it will be used to evaluate and further develop the design of the app and eventually be presented in a final report. This report along with the data and recordings may be shared or presented in scientific journals or conferences. We never share children's names, schools or other personal information.

How will personal information be protected?

Confidentiality is extremely important to us. Recordings and other information (such as forms with children's names) will be stored safely on password-protected computers or in locked cabinets. Access will be limited to the people involved in the research (listed above). Recordings and other information will be identified only by participant codes or pseudonyms, and will be separated from identifying information (such as name or birth date).

Can I have a copy of the games?

The app prototypes your child would play with in this study are merely proof-of-concept; that is, they are pieces of research software designed to help answer specific questions. They do not

have the same type of functionality, amount of content, or style of documentation that you may expect from commercial games. However, once the study is over the games may be made publicly available online, for free unlimited use. If so we will send you a link and instructions for installation.

Who paid for this research?

This study is part of the postgraduate or personal research for the main researchers (listed above). It is indirectly paid for by the University of Edinburgh and the funding is not attached to a specific project or to any outcomes of that project. Conducting this research brings no financial benefit to the researchers or to the university.

Would you like to participate?

We ask parents to read this information sheet so you can make an informed decision about whether participation is a good idea for your child.

If you say “yes” when returning the permission form, we will explain the role for each workshop to your child, and ask him/her if he/she wants to help. We will remind your child that they can stop at any time, without having to give any reason, and that we will always listen to them. We will check that the child agrees to be audio (and possibly video) recorded. This explanation will be based on the child information sheet included in this packet. We feel strongly that children should be given a real choice about whether to participate. Even if you say “yes” on the permission form, your child may still say “no” if s/he does not want to be a game developer. We will respect your child’s decision.

If you say “no”, we will not contact you again about this study and will not speak to your child about participating in these workshops.

Once again, this study is completely voluntary and you and your child are under no obligation to take part. Even if you say yes now, you may withdraw your child from the study at any time and for any reason by contacting us. Your child may also withdraw at any time by saying that s/he does not want to be a game developer any more.

Thank you for taking the time to read this.

If you would like to know more about this research and/or if you have questions, please contact one of the main researchers listed above.

Appendix B: Information Sheet for children

Designing and testing games for children/ Talking living skills *(may be read aloud to the child)*

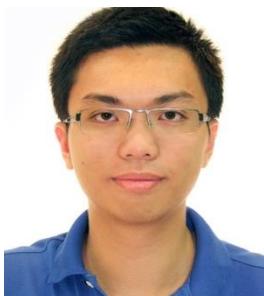
This page is for children. Some researchers are organising an **event at University of Edinburgh**. It says who they are, and what they will do **during the event**.

They will ask you to help design a new computer game, comment on pictures, **participating in different activities** and answering a few questions. You can decide if you want to say “yes” or “no” to helping, and can change your mind at any time.

Who is organising the event? This is Helen, Nemo, Yan, Zhao and Amrita. Their job is to make computer games for children and to improve daily living skills for children. They will ask you to help them by providing ideas for new computer games, and tell them what they think and feel about pictures, participating in different activities and answering some questions.



Helen



Nemo



Yan



Amrita



Zhao

How can I help?

Yan want to teach children how to have a good communication with others. There are some scenes in this game that children may encounter in their daily life. These scenes contain the interactives between children and others. this game will guide children how to deal with the interactive on a better way

Zhao wants to design a game that help children cross the street safely. You can help by sharing your experience about crossing the street, and the creative thinking for the game, such as characters and rewards. You can tell the rules you know and point the bad behaviour in some pictures.

Nemo wants to teach past tense to children. You can help come up with a story for others to learn past tense with, minigames and other rewards that the game could have, what kind of partner you might want, and what past tense verbs you think other children might find hard

Amrita wants to look at how children talk to one another and she wants to find out more about the rules of conversation. Her game involves role-playing as a hero on a quest that interacts with a “Game Master” and you can help by giving ideas for the quest as well as coming up with goals, obstacles and characters.

What will happen if I help? When you arrive, you will be told more information about the activities in the workshop. Then, you will get to take part in design workshops and participate in other activities. Later you may get to play with the game prototype.

You can tell us if you want to stop doing any of the activities. You do not have to tell us why. Please tell us if you need the toilet, or if you want to take a break. You can also say you do not want to help any more, and that is OK. We will always listen to you.

The researchers will ask if it is OK to make an audio or video recording of you helping design the game, doing activities and answering questions. This is because it is too hard for them to write down everything that happens. They will listen to or watch the recording later to help them understand what you said, or your ideas for the game.

What will happen after I am finished helping? They will learn a lot about children and computers from the things you make, do and say when you take part in the workshops and activities, or later when you play the games. They will write about what they have learned, and use it to design their games. Sometimes they will show people recordings of children taking part in the different activities.

Do you want to ask a question about being a games developer? It is OK to have more questions. You can ask the researchers as many questions as you want about being

a game developer. Ask your mum or dad to help you call them on the phone or write an email with your question.

Your mum or dad said it is OK for you to help us.

Do you want to be a games developer? You can say “yes” or “no”. It is OK to say “no”. It will not hurt the researchers’ feelings.

Appendix C: Parent's consent form

Research consent form (for parents)

Please Circle

Have you read the information sheets? YES / NO

Have you received enough information about the study? YES / NO

Do you understand that participation is completely voluntary and your child can leave the study at any time, without having to give a reason? YES / NO

Please sign this page to indicate that you understand and accept the conditions of this study, including audio and video recording. By signing, you agree that the researchers may explain the study to your child and invite him or her to take part as a game/web designer or in appreciating art.

With reference to further anonymous use of photographic, audio or video data, please circle yes or no in response to the following:

I AGREE that short videos/images of my child can be used as examples in documents and presentations for research and/or teaching purposes.

YES / NO

If you give permission for this study, please return this form to the researchers.

If you DO NOT wish to give permission, you do not need to return this page. We will not ask your child to participate.

Full name of child (to appear on certificate): _____

Child's date of birth (DD/MM/YYYY): ____ / ____ / ____

Your relationship to the child: _____

Your name (please print clearly): _____

Contact telephone number: _____

E-mail address: _____

Signature:

Date: ____ / ____ / ____

Appendix D: Child consent form

Child Consent Form

To be used as a guide for securing consent or refusal, after the child has had a chance to get information about the study. The child may mark (or be helped to mark) this form, or the child's consent/refusal may be video-recorded.

I can choose to design and test games and describe pictures.

I do not have to help if I don't want to.

I can decide to stop taking part or take a break if I want to.

I do not have to say why.

It is okay if I change my mind later, and say I do not want to help anymore.

It is okay if some activities are hard for me!

There are no wrong answers to questions.

Anything I can do is helpful.

Do you want to design and test games and describe pictures? YES NO

Nemo, Yan, Amrita, Zhao and Helen will listen to/watch the recordings later. They may show them to other people who make games for children or are interested in art.

Is it okay to take audio/video recordings? YES NO

Write your name: _____ and age: _____

THANK YOU!

Appendix E: Certificate for children who completed the design workshop



Figure 14. Certificate awarded to children for participating in the design workshops

Appendix F: Certificate for children who completed the evaluation workshop



Figure 15. Certificate awarded to children for participating in the evaluation workshops

Appendix G: Storyboard of the main story of ‘Where’s Grandpa?’

For this walkthrough, sections within boxes are branches in the game that show what happens when players pick an option.

The game starts with a picture of the main menu. Players can choose either ‘Play Main Story’ or ‘Play Grandpa’s Story’. To quit the game, players can choose ‘Quit’. In the final game, ‘Play Grandpa’s Story’ will be blanked out or hidden and can only be chosen after players finish playing the Main Story.



Figure 16. Screenshot from the main menu of the game ‘Where’s Grandpa?’ Showing 3 clickable options.

After clicking ‘Play Main Story’, a dialogue box shows up saying ‘Hello? Is somebody there?’ from a character named Polly, with no sprite shown on screen. Players click within the dialogue box to proceed with the story.

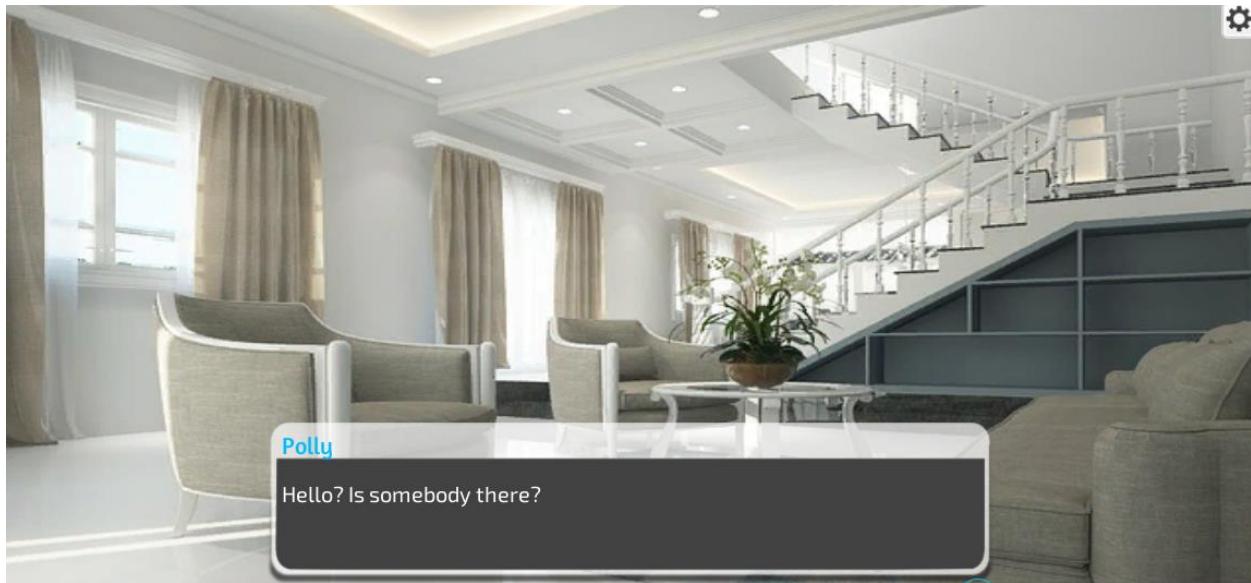


Figure 17. Screenshot showing Polly, unseen, asking for somebody.

After asking ‘Hello?’ once more, a sprite of an Owl appears and introduces herself as Polly. The word ‘startled’ is highlighted in green to begin drawing attention to regular past tense words.

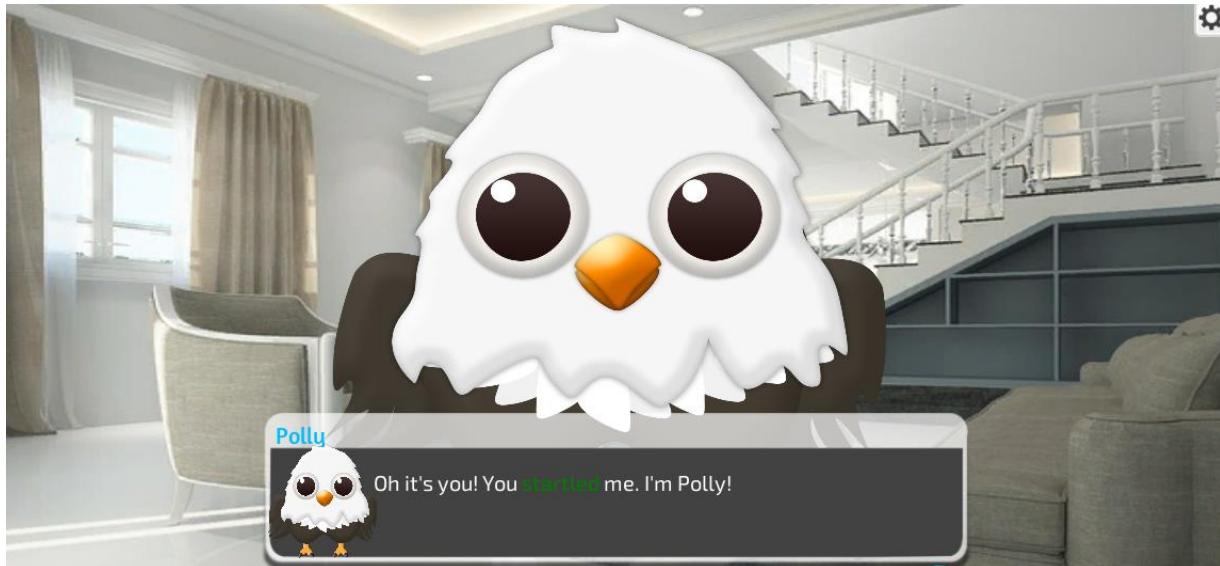


Figure 18. Screenshot showing how the player as the main character startled Polly. Startled is in green to highlight that it is a past tense verb.

Polly then says that Grandpa has jumped into ‘the travel machine’ and asks for the player’s help. A choice comes up on whether to help or not. Players can choose by clicking one of the two options provided.



Figure 19. Screenshot showing the first branching option players can take in the game, whether to help Polly or not.

Choosing 'No, I want to quit'

If players choose not to help, Polly asks whether the players are sure and says that she 'could really use your help'. The choice comes up again to quit or help Polly. If players choose 'No, I really want to quit', Polly says 'Aww, alright then. I hope Grandpa is okay. Come back if you change your mind!' and the game quits. If players instead choose 'Yes, I will help you', then the game continues as if they had chosen to help Polly the first time.



Figure 20. Screenshot of the consequence of the player refusing to help Polly. Polly asks the player to return if they change their mind.

Choosing 'Yes, I will help you'

Polly says 'You will? That's great! Let's go!' and the scene transitions by fading to black. A picture of a zoo appears. Polly says 'Wow, this must be the zoo! I think I can see some of my friends!'

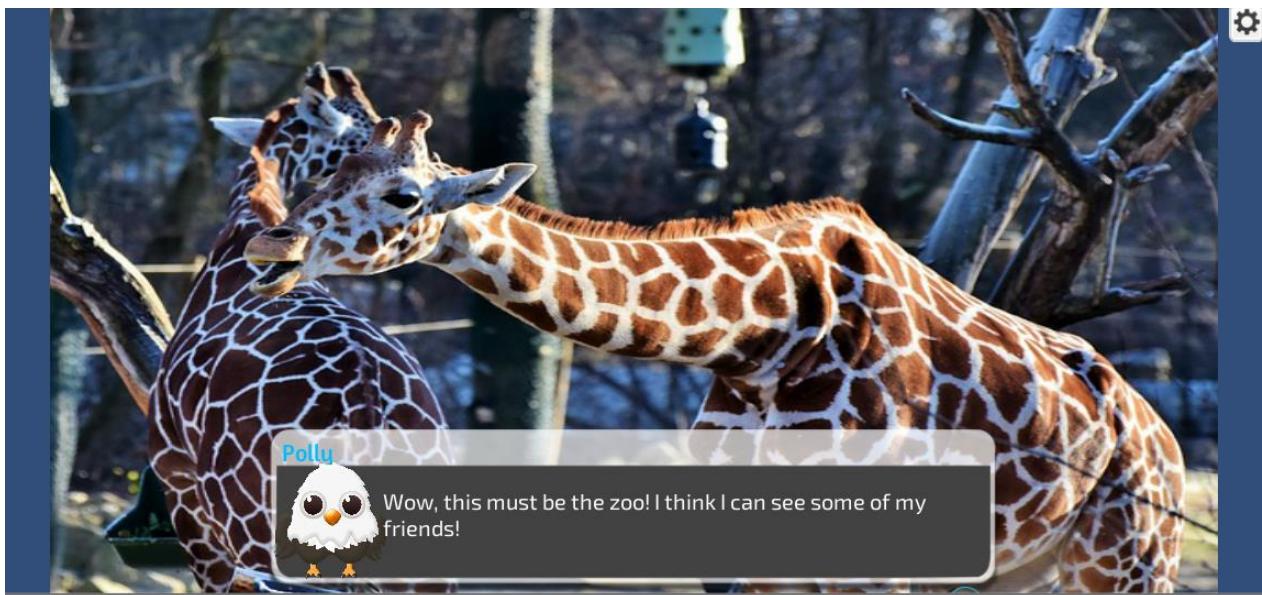


Figure 21. Screenshot of the zoo, the first location that players visit.

Polly then says that she knows some of the animals and asks the player what their favourite animal is. The choices include 'Tiger', 'Turtle', 'Elephant', 'Snake', 'Another animal', and 'I don't like animals'.

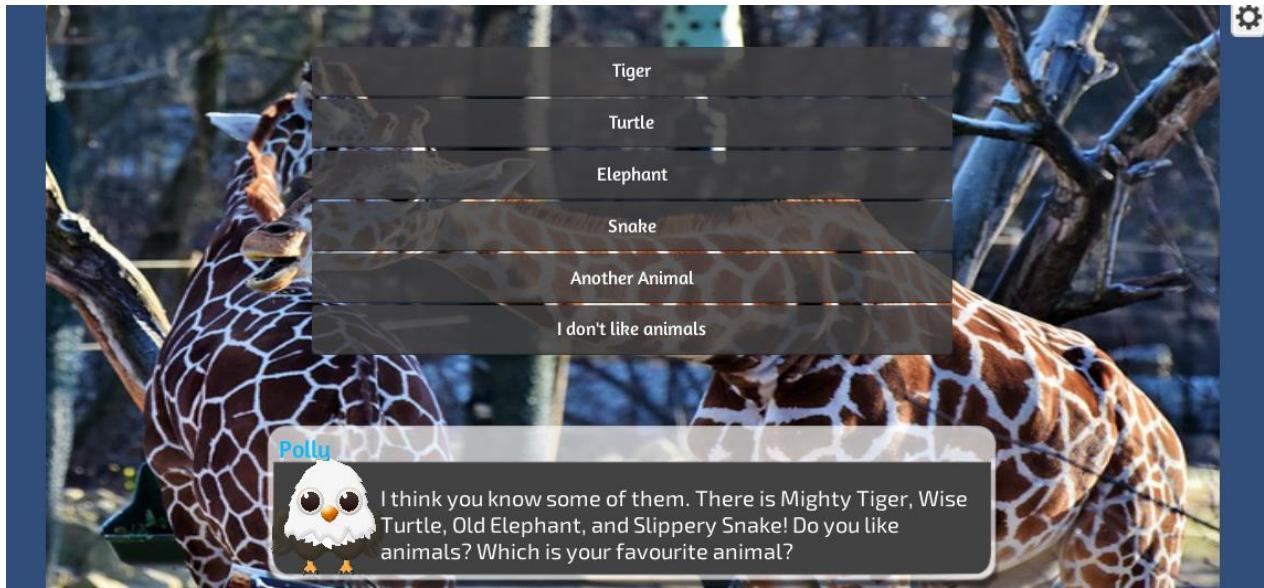


Figure 22. Screenshot showing the second branching options players can make. Here, Polly is asking the player what animal they like.

Choosing any option

Choosing any option will lead to Polly replying with a unique response to each one. For example, by choosing 'Snake', she says 'Sssslippery snake! She's so slippery! Snake can be scary at times, but she's so gentle and nice.' Picking the tiger will have her say 'Roar! I like the tiger too! He's strong and powerful! I'm sure one day you will grow up to be just as powerful as a tiger!'

Choosing 'Another animal' has Polly saying that only the animals that can be chosen are 'not sleeping', although 'they are here somewhere!'. Choosing 'I don't like animals' has Polly saying 'that's ok' and that while animals 'can be a little scary sometimes, but [the animals] are scared of [the player] too!'



Figure 23. Screenshot of the consequence of choosing 'I don't like animals'. Polly reassures the character that animals are scared of the player too.

Choosing any option

Regardless of what the player chose, a sprite of a man appears as Polly wonders 'if there's anyone here'.

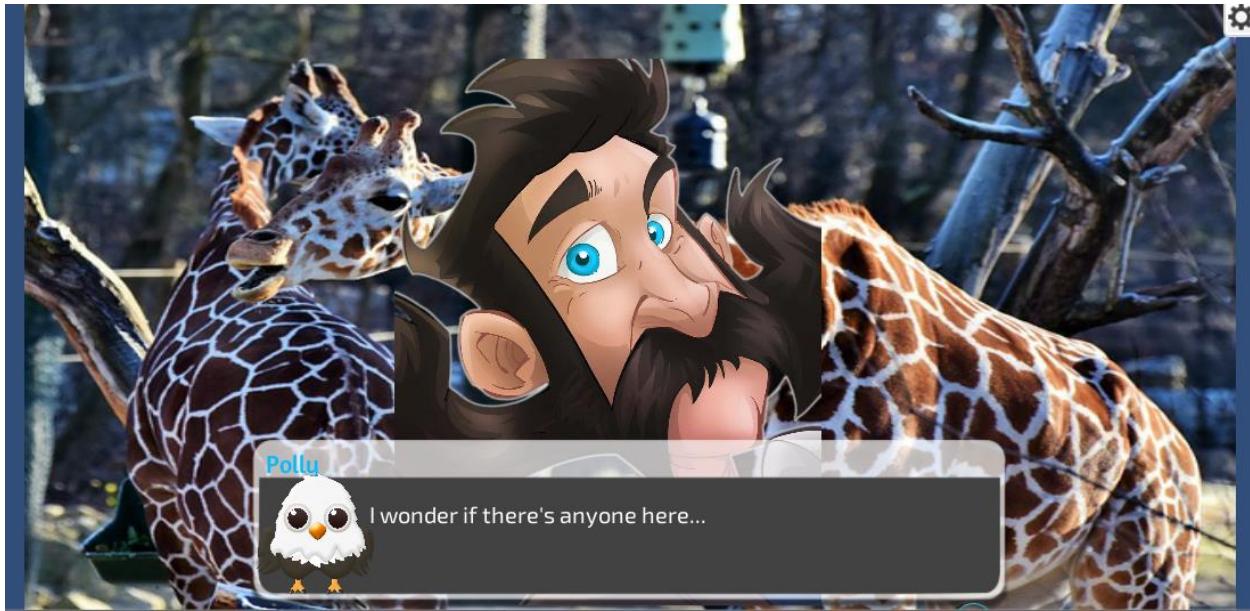


Figure 24. Screenshot showing how any option leads back to the main story, with Polly asking if anyone is present while the Zookeeper's sprite appears.

Polly gets scared and the man apologises and tells the player and Polly that Grandpa had told him that they would come. The zookeeper says that Grandpa wants to play a game where the player and Polly find Grandpa.

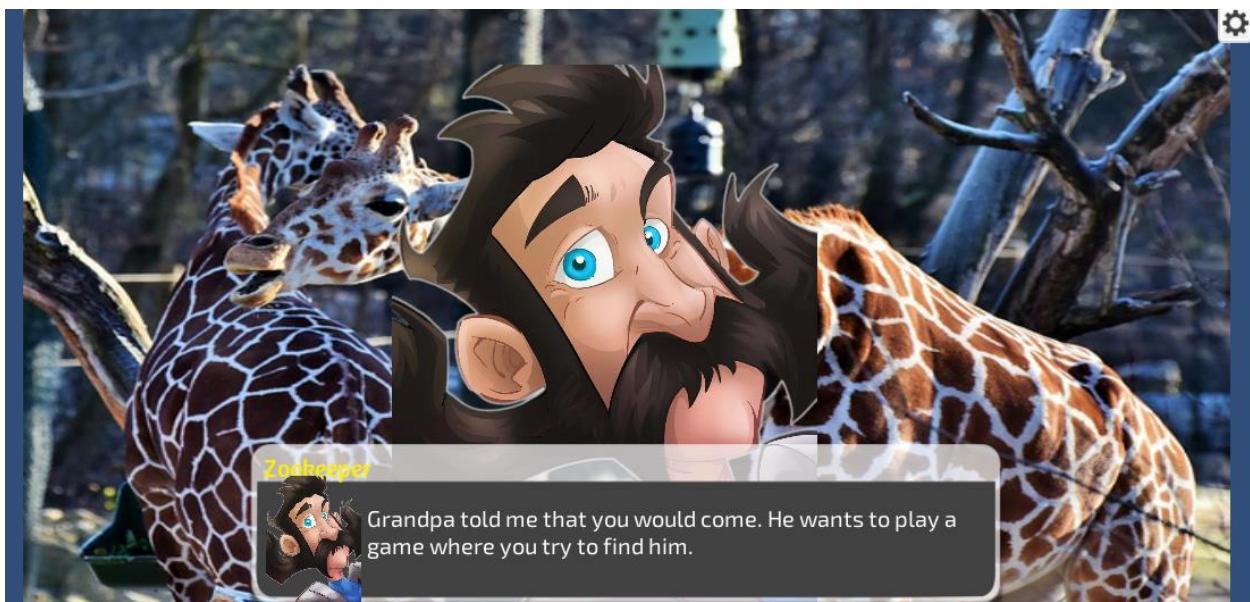


Figure 25. Screenshot showing the Zookeeper telling the player and Polly that Grandpa wants to play a game with them.

Polly asks why the zookeeper can't just tell them where Grandpa is, and he replies that 'Grandpa thought it would be fun'. Polly says that's just like Grandpa, 'so mysterious!' and asks what game they are playing. The zookeeper says that Grandpa wants to talk about 'things [he] did before [he] met [the player and Polly].'



Figure 26. Screenshots showing a) What the game will be about and b) what topics the Zookeeper will talk about.

Polly, as a way of reflection, repeats what the zookeeper said in different words.

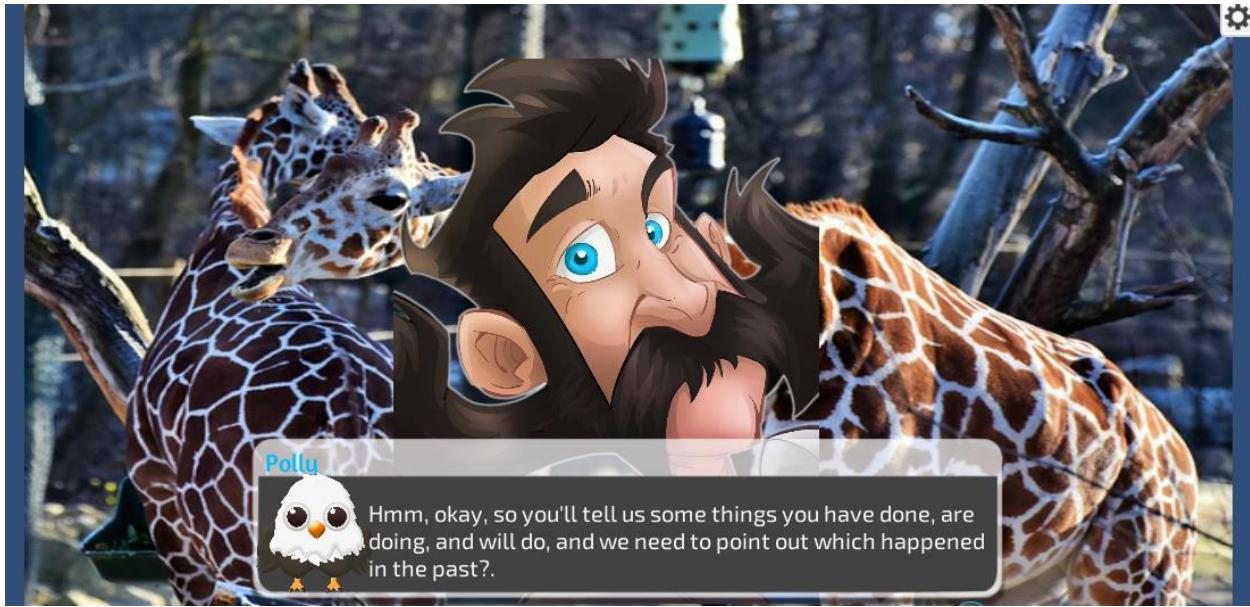


Figure 27. Screenshot where Polly reflects what the Zookeeper back to him to reinforce the player's understanding of what to do.

Polly then asks if the player understands how to play the game.

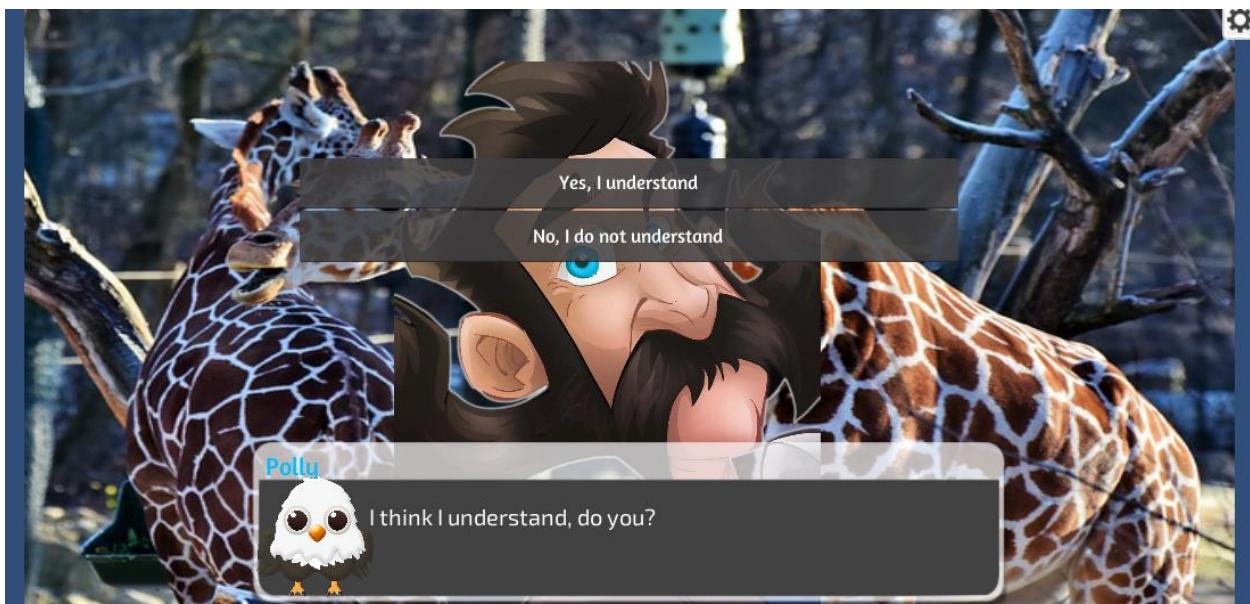


Figure 28. Screenshot where players can state whether they have understood what to do to progress in the game.

Choosing 'No, I do not understand'

Polly says 'Hmm, think about three things you did today. Those are all things that happened in the past.' She continues with 'One example is that you started to play this game. See? Started is a past tense word.'

She reassures the player that 'it's okay if you don't understand yet.' And the game continues as if the player had picked 'Yes, I understand'.

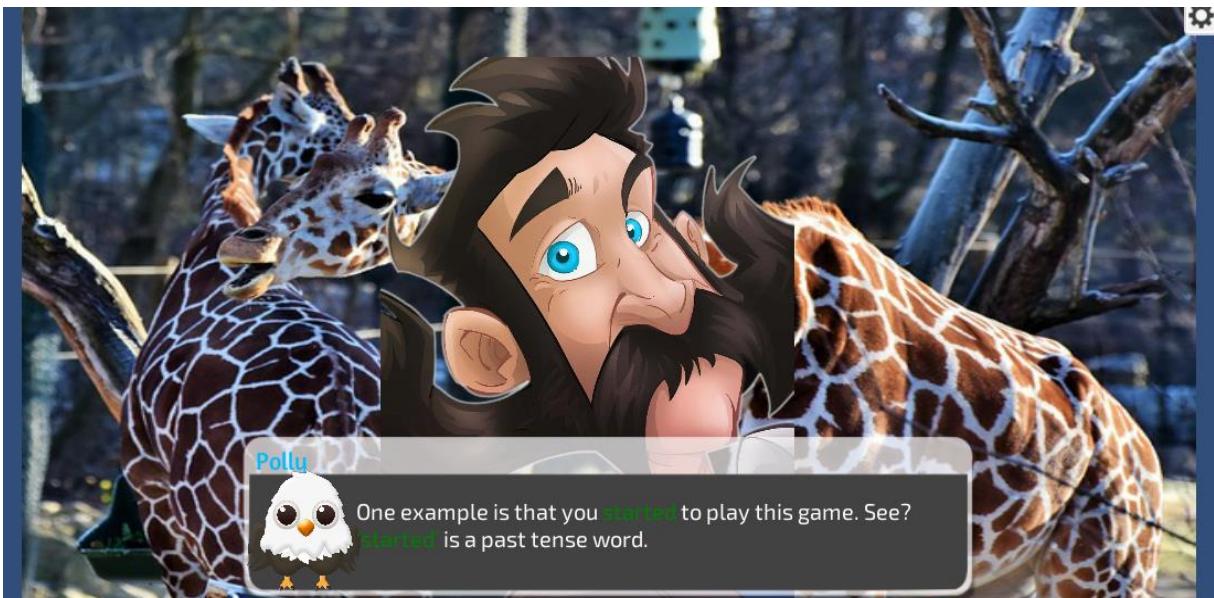


Figure 29. Screenshot where Polly gives an example of what a past tense word is. This dialogue appears if players state that they do not understand what to do.

Choosing 'Yes, I understand'

A dialogue box appears that tells the player to look out for words that are highlighted in green as they talk about things that happened 'yesterday, or last week'.



Figure 30. Screenshot where the narrator tells the player what kind of words to look out for and what they do.

The zookeeper then asks 'What did I do before I met you here?' After that, a dialogue box pops up explaining the 3 options that comes up.

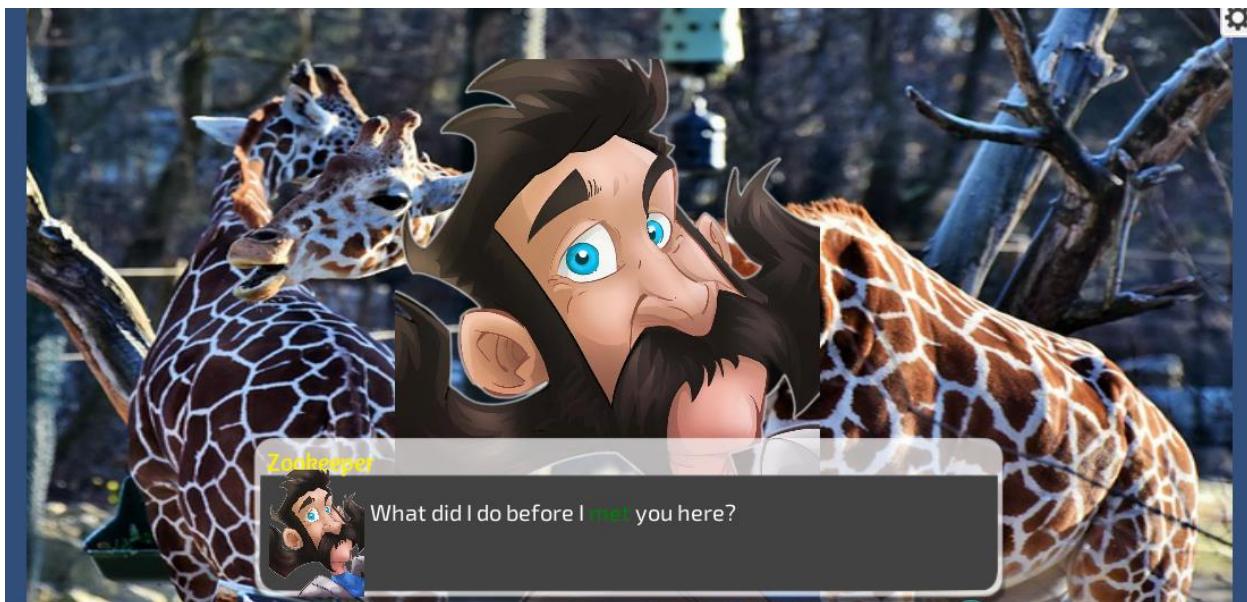


Figure 31. Screenshot showing the Zookeeper beginning to ask his question.



Figure 32. Screenshot of the instructions telling players what to do when the questions appear.

The 3 things the zookeeper did and the options are then made available.

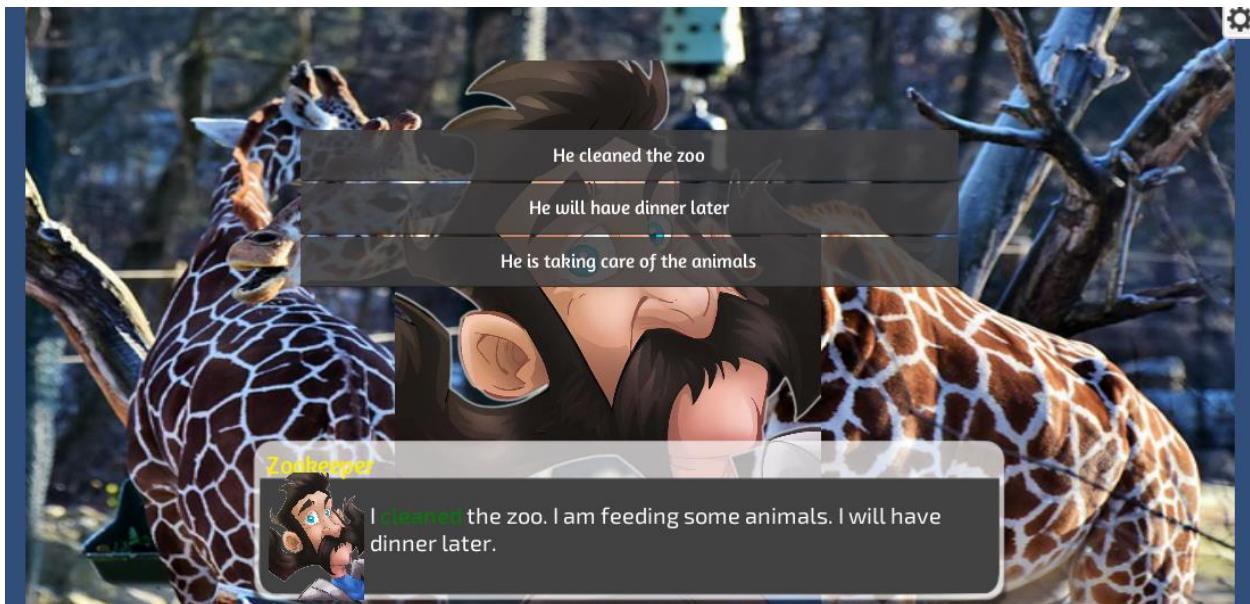


Figure 33. Screenshot of the first linguistic question in the game. Here the Zookeeper tells something about what he did in the past, is doing in the present, and will do in the future. Players pick a sentence in order to answer what the Zookeeper did in the past.

Choosing 'He will have dinner later'

Polly tells the player that 'he will have dinner in the future, meaning it did not happen before he met us!' The instructions are replayed and when the question appears, the 'He will have dinner later' option disappears, and remaining options are shuffled.

Choosing 'He is taking care of the animals'

Polly tells the player that 'he is feeding the animals just now, which is not what he did before he met us! Try again. The instructions are replayed and when the question appears, the 'He is taking care of the animals' option disappears, and remaining options are shuffled.

If players pick both wrong options, only the right option remains.

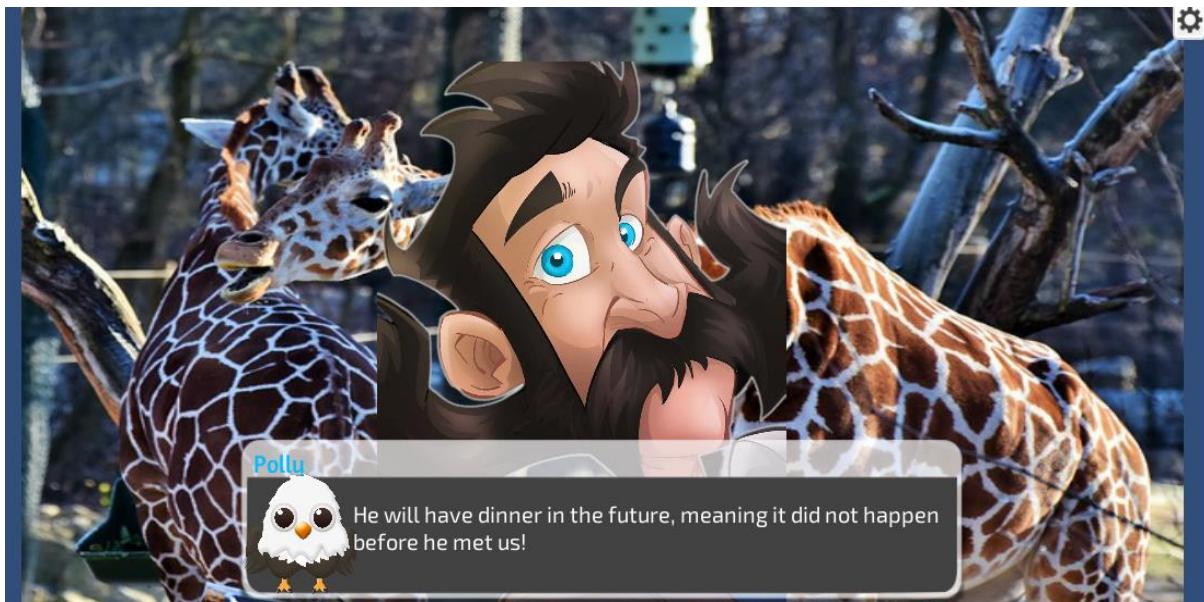


Figure 34. Screenshot showing what happens when players pick 'He will have dinner later'.

Choosing 'He cleaned the zoo'

The zookeeper asks how the players knew that the zookeeper cleaned the zoo before he met the player and Polly. Simultaneously, a picture of a vacuum, broom, and bucket appears that grows bigger and smaller alternatingly. Polly explains that they knew because of the 'ed' at the end of the word, after which the zookeeper warns the player that not all past tense words ends in 'ed'.

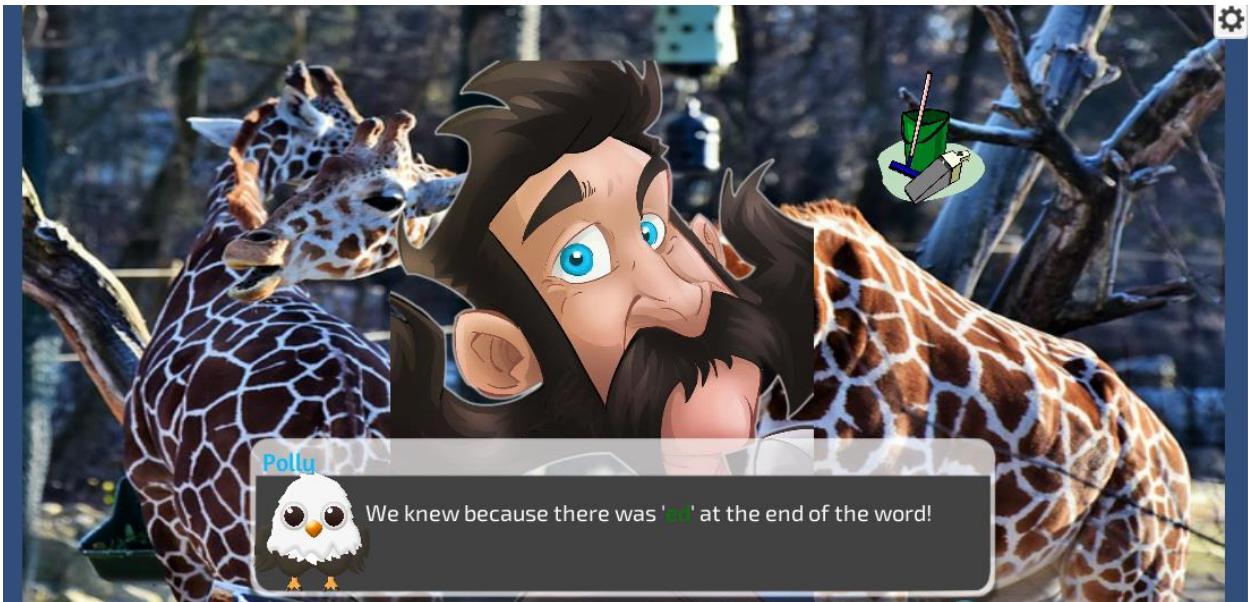
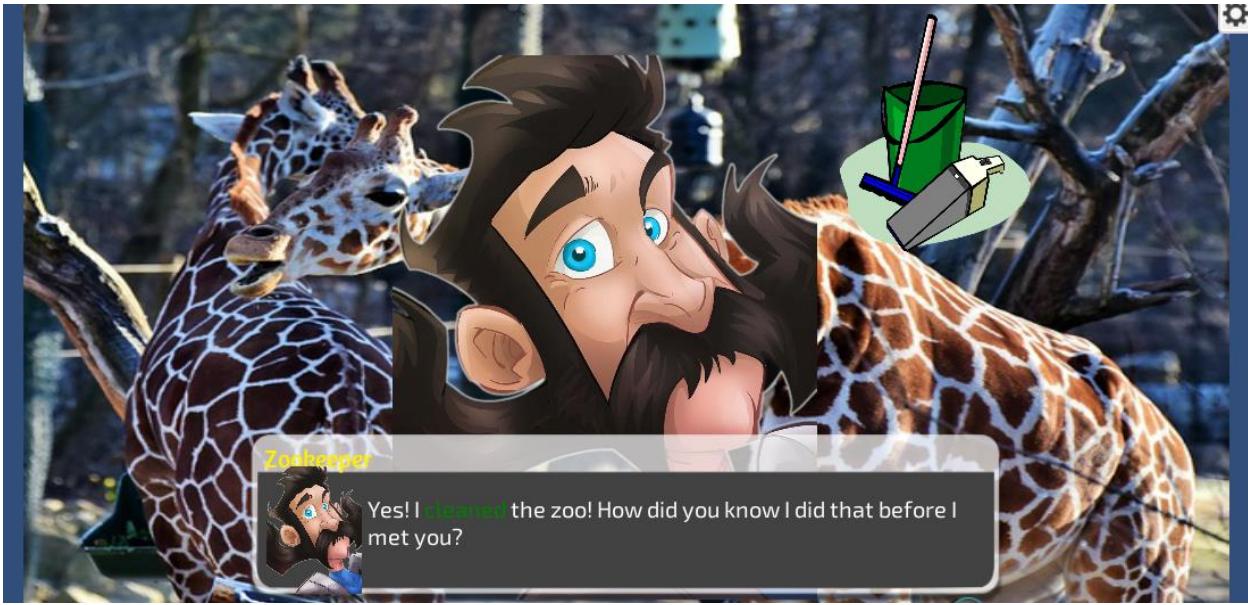


Figure 35. Screenshots showing a) the Zookeeper affirming that the player chose the right answer and b) Polly explaining how the player and Polly knew which option was correct by explaining a general rule.

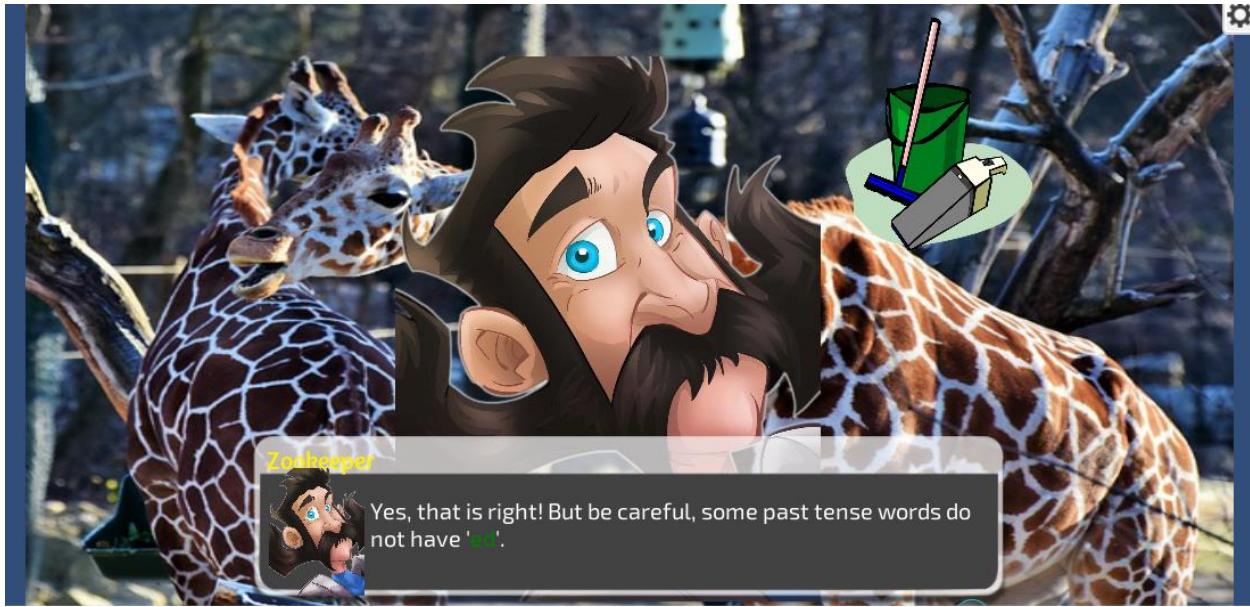


Figure 36. Screenshot showing the animated cleaning equipment that appears as a reward to players. The Zookeeper warns against overgeneralisation of the rule Polly explained in figure 35b.

The zookeeper then informs the pair that Grandpa has gone to the park. The scene transitions to the park. Polly says that she doesn't see anybody there, after which she says that she likes parks and that she lived in a park before.

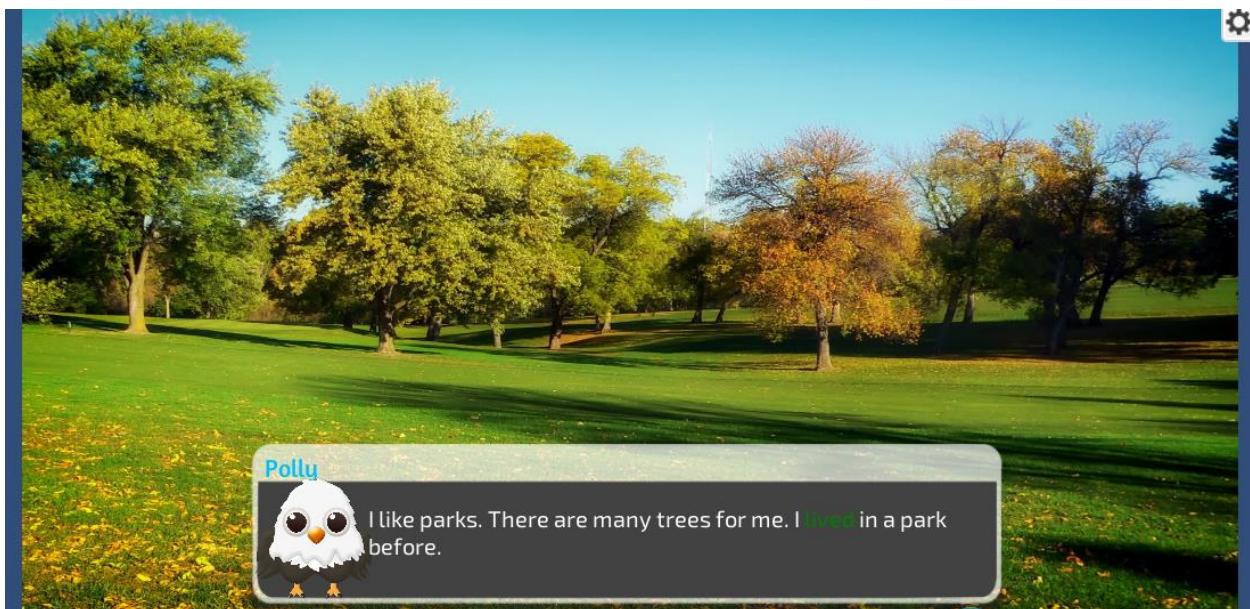


Figure 37. Screenshot showing the Park, the second location players visit. Polly is explaining that she lived in a park in the past.

The park ranger appears and explains that they have to play a game again. This time, explaining that the player has to tell her what the park ranger used to like to do.

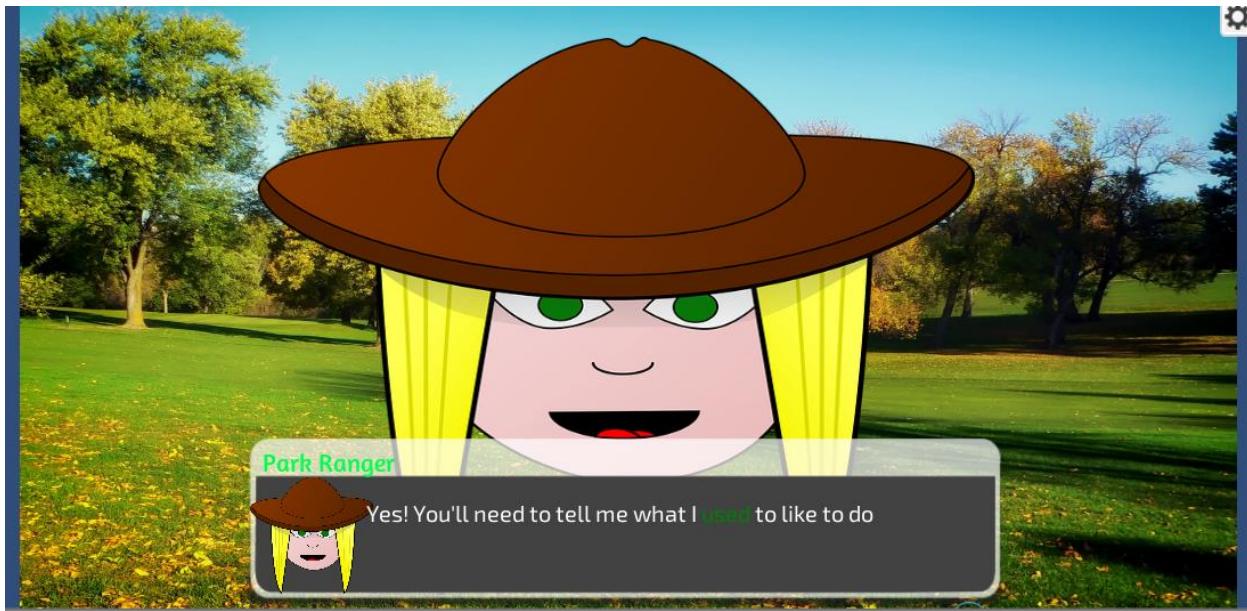


Figure 38. Screenshot showing the Park Ranger explaining what kind of question the player needs to answer to progress in the game.

She then asks what she liked when she was younger, explaining that she liked to jog when younger, swim in the swimming pool every week, and that she will like a different hobby when she is older.

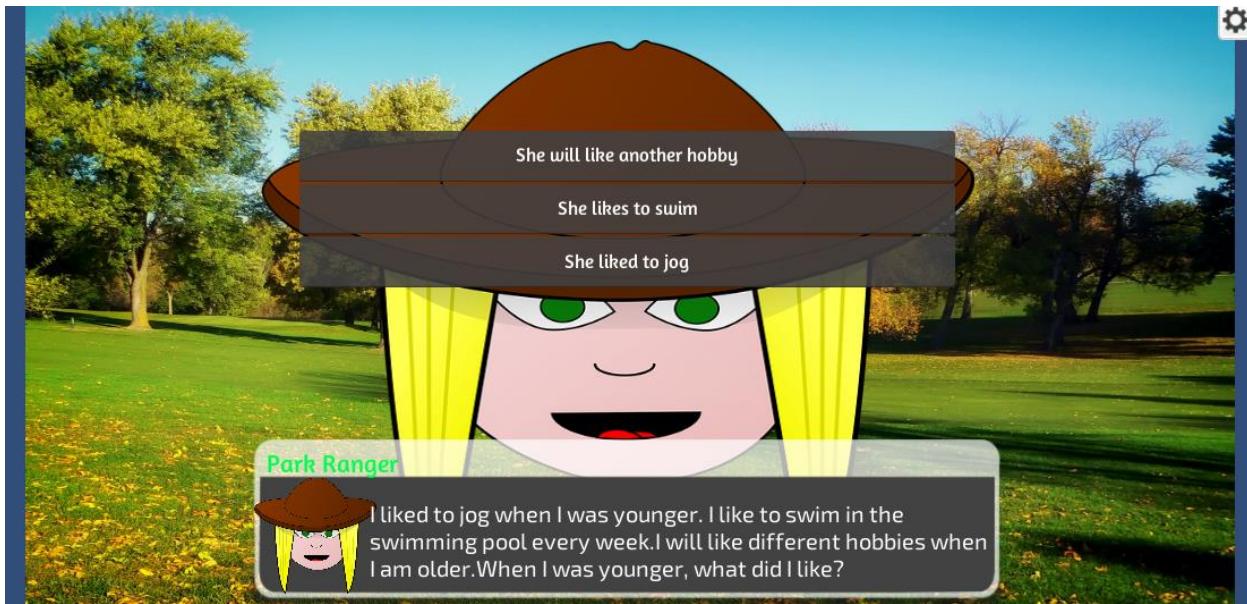


Figure 39. Screenshot showing the second linguistic question players need to answer to progress in the game. The

Park Ranger uses 3 different tenses of the word ‘like’ in sentences and players have to choose the tense that explains what she liked to do in the past.

Choosing ‘She likes to swim’

Polly says ‘She really likes swimming! But she likes doing it now, not in the past! Try again!’ The Park Ranger’s question plays again, the option ‘She likes to swim’ disappears, and remaining options are shuffled.

Choosing ‘She will like another hobby’

Polly says ‘Aha, what hobby will she like next time? We will see!’ The Park Ranger’s question plays again, the option ‘She will like another hobby’ disappears, and remaining options are shuffled.

Choosing ‘She liked to jog’

The player is rewarded with an animated stick figure of a man moving from left to right. The park ranger also says that she jogged, but does not jog anymore.

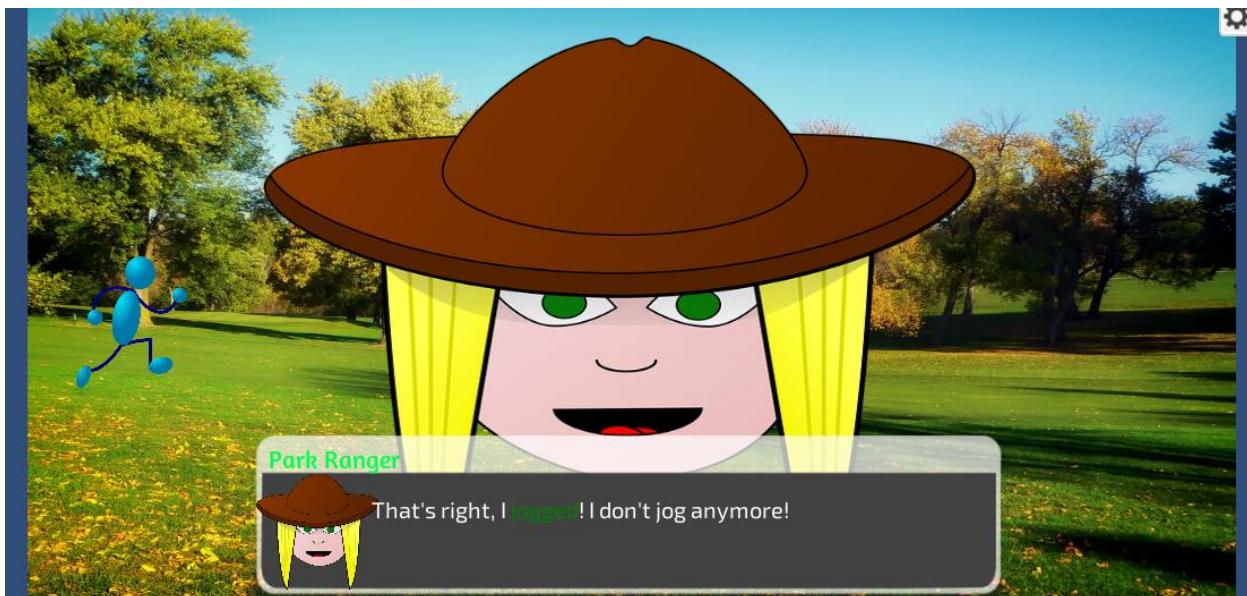


Figure 40. Screenshot showing the stick figure that moves from left to right as a reward for answering the question correctly. The Park Ranger affirms that the player has picked the correct answer.

The Park Ranger then encourages the player by saying that they are really smart. She then says that Grandpa went to the train station.



Figure 41. Screenshot where the Park Ranger encourages the player with praise. Note the running man having moved from the left side of the screen to the right.

The screen transitions to the train station. Polly exclaims that there is a train in the background and asks the player whether they like trains.

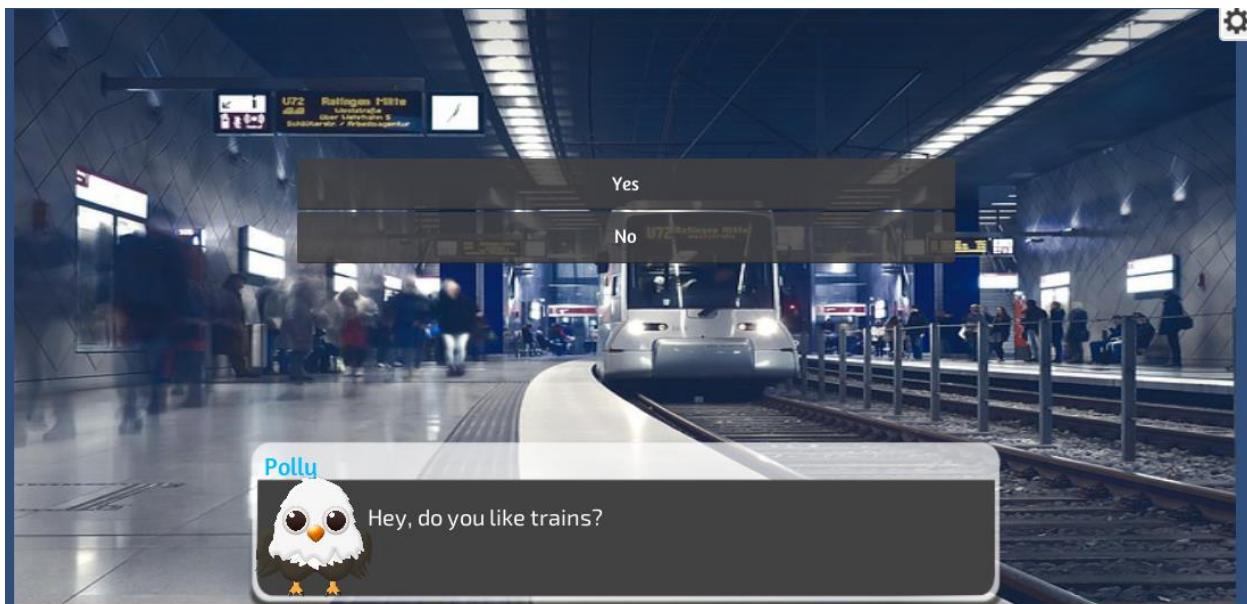


Figure 42. Screenshot showing the Train Station and Polly asking the player whether they like trains.

Polly again responds to each option in a unique way and the main story continues without consequence.

Choosing 'No'

Polly says 'I like them, but they can be so loud can't they?' and ends with 'I was on a train on holiday once, but it was so noisy I could not sleep at all!'

Choosing 'Yes'

Polly says 'That's so cool! I like trains too!', continues with 'I sat on a train when I was on holiday, and all the buildings rushed by!' and ends with 'It was so fun!'

Choosing either option

Someone unseen calls out 'Watch out!' and Polly wonders who said that. A man identified as the Station Master appears and apologises, saying he did not mean it. Polly says that she's hurt her wing



Figure 43. Screenshot showing the Station Master apologizing for crashing into Polly. The Station Master's dialogue was written to be a little different, with him repeating dialogue once more.



Figure 44. Screenshot of Polly saying that she is hurt.

The Station Master says that he has seen Grandpa recently, and that they will have to play a game. Polly interrupts and finishes his sentence.



Figure 45. Screenshot of the Station Master beginning a sentence, but being unable to finish as he is interrupted.

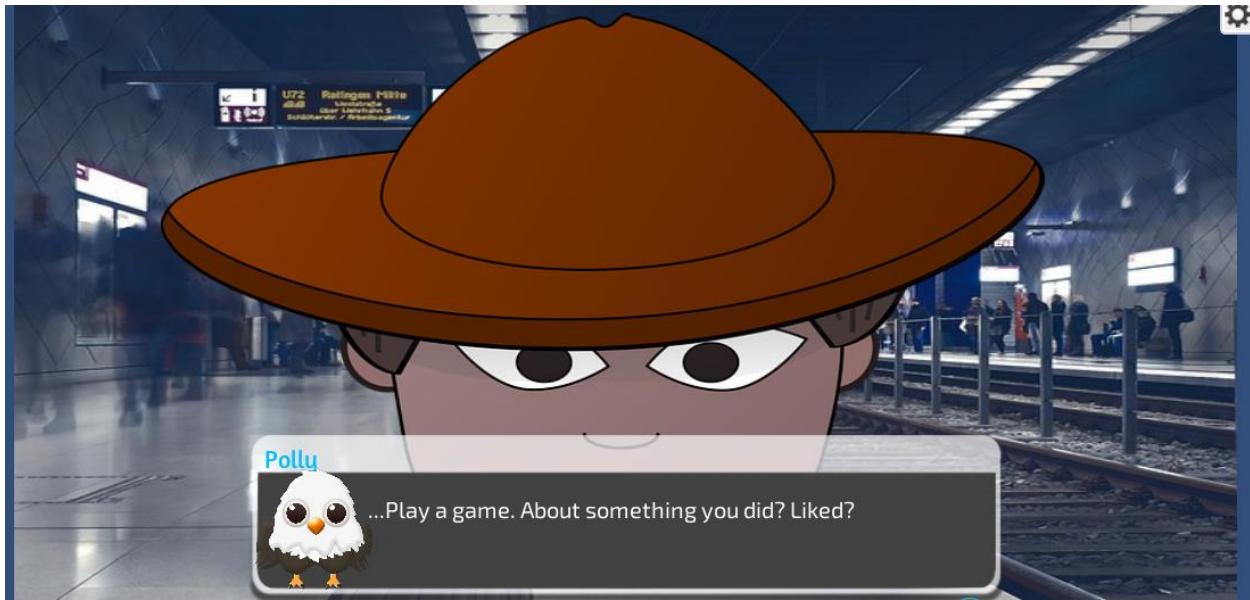


Figure 46. Screenshot showing Polly interrupting the Station Master and finishing his sentence.

The Station Master informs them that they have to give a word that says that '[he] did this yesterday'. Polly says that this is 'a bit different' and reflects what the Station Master said.



Figure 47. Screenshot of the Station Master explaining what the player needs to do to answer the next linguistic question.

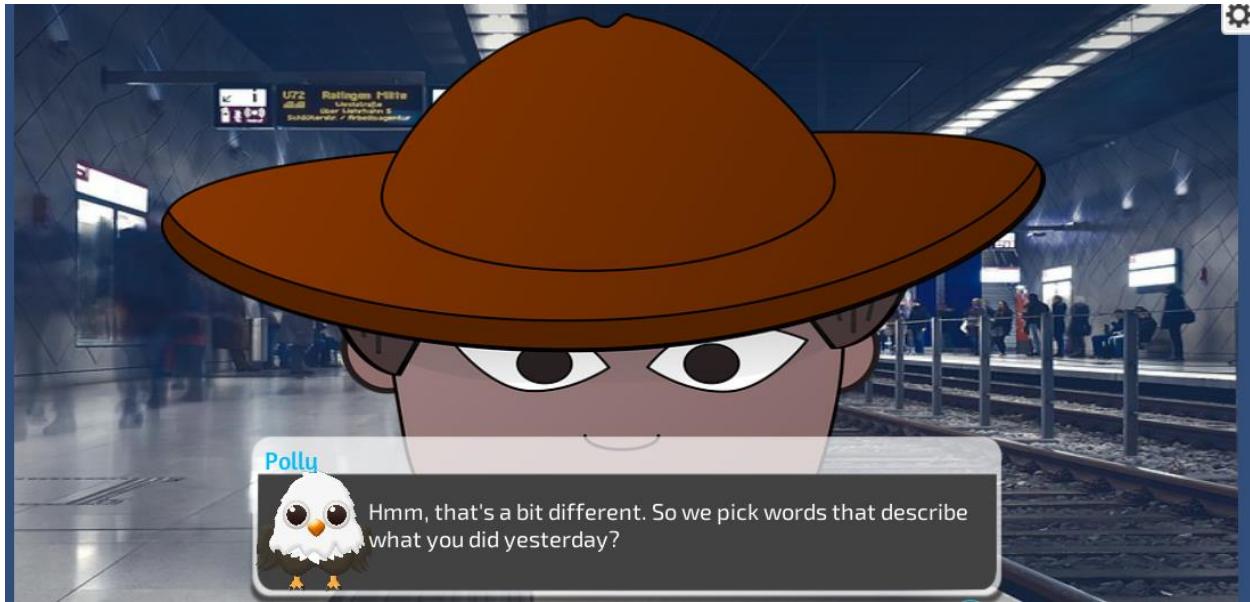


Figure 48. Screenshot of Polly reflecting what the Station Master said back to him to reinforce what needs to be done.

The players are then told that the words are not highlighted in green anymore.



Figure 49. Screenshot of the narrator explaining to the player that words are no longer highlighted in green.

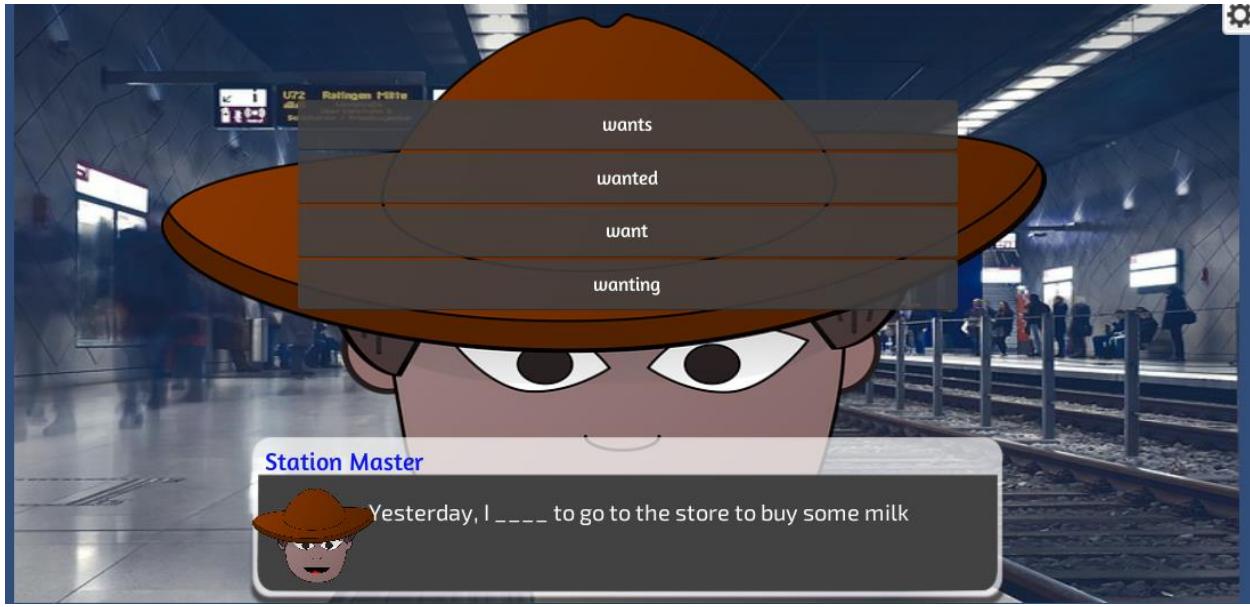


Figure 50. Screenshot showing the Station Master asking the third linguistic question. Players pick the correct form of the word ‘want’ to fill in the blank in the Station Master’s sentence.

Choosing any option besides ‘wanted’

Polly simply says ‘No, that’s not quite right, try again’ and the players need to choose the right answer again. The option then disappears and the other options are shuffled.

Choosing ‘wanted’

An animation of a milk carton tilting from left to right plays and asks how the player knew how to choose the word ‘wanted’. Polly replies that they knew because of ‘ed’, reinforcing the lesson. The Train Master then tells them that Grandpa went to a volcano and the pair travel using the travel machine.

Instead of the volcano, players are taken to space, where Polly takes a moment to orient herself and the player.

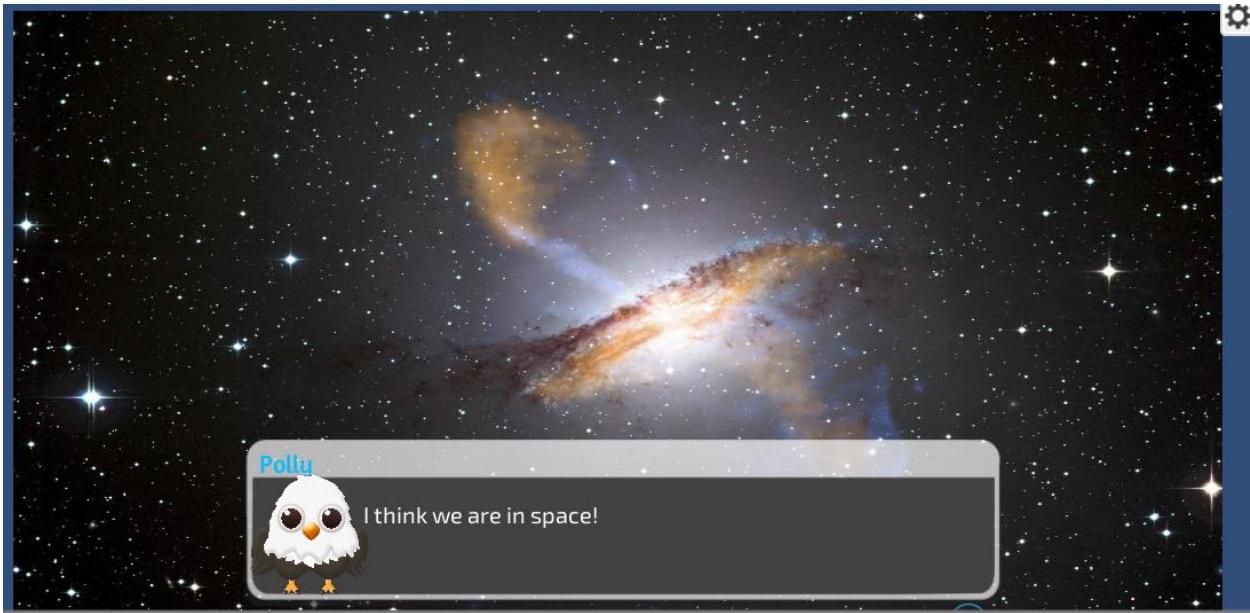


Figure 51. Screenshot of Space, the fourth location players visit. Polly takes some time to orient both herself and the player.

After wondering how they got there, a blue alien appears on screen and scares Polly. Polly asks who the alien is. He replies saying that he wants to learn about the player and Polly's language



Figure 52. Screenshot of the Alien as he explains what he wants the player and Polly to do.

He then says that he has been watching the player and Polly's adventures and that he would appreciate if it were them who helped him. He says that he knows Polly's name and that 'you', referring to the player,

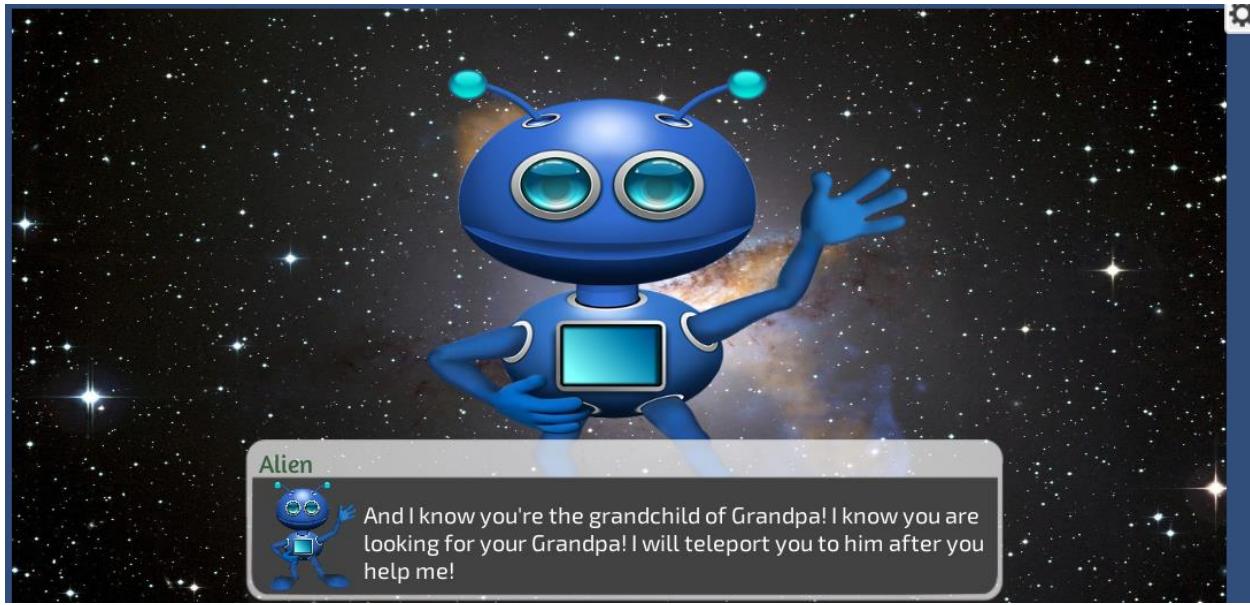


Figure 53. Screenshot of the Alien saying he knows who the player is and that the story will progress after the player helps him.

Polly agrees to help the alien on behalf of the player and herself and the alien asks his question. He asks what he might have done last week. This was done to represent the hardest question a child could face in the final game.

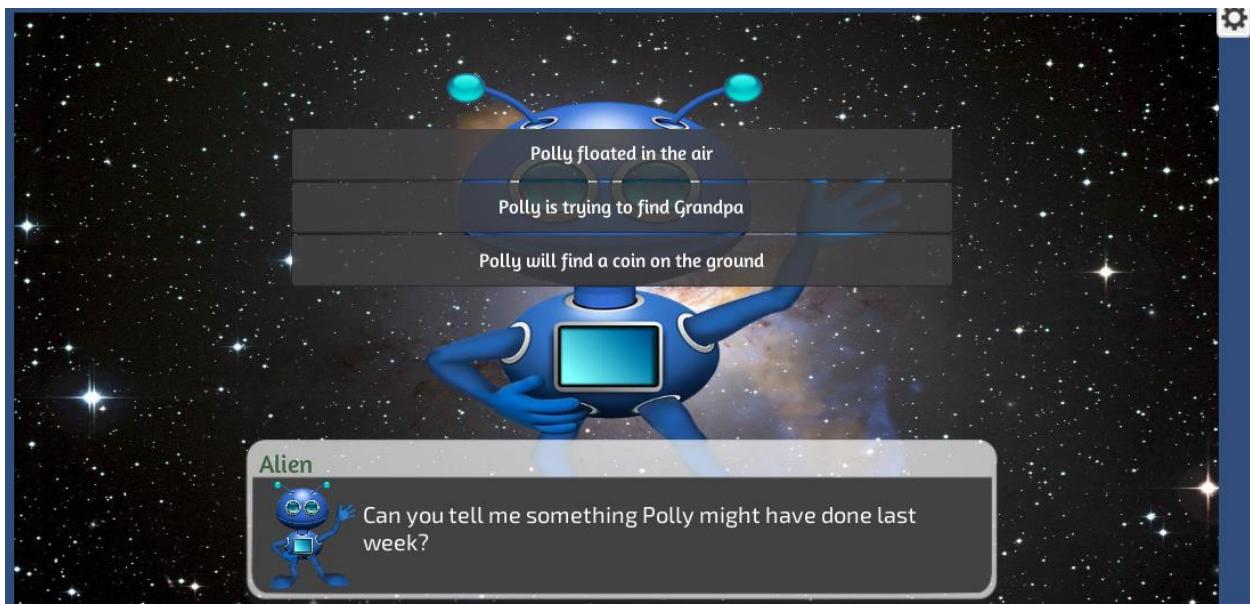


Figure 54. Screenshot showing the last linguistic question players answer. This question represents the hardest question that players will face in the final game.

Choosing ‘Polly is trying to find Grandpa’

Polly says ‘I’m trying to find Grandpa now, not last week!’ The question reappears, the option ‘Polly is trying to find Grandpa’ disappears, and remaining options are shuffled.

Choosing ‘Polly will find a coin on the ground’

Polly says ‘I did not find a coin last week!’ The question reappears, the option ‘Polly will find a coin on the ground’ disappears, and remaining options are shuffled.

Choosing ‘Polly floated in the air last week’

The player is rewarded with an animation of Polly the Owl moving up and down. The alien thanks the player and Polly for their help, saying that he ‘understand[s] [their] language better’. He then sends the pair to Grandpa. The scene then transitions to the volcano.

Polly comments on how the volcano looks amazing.

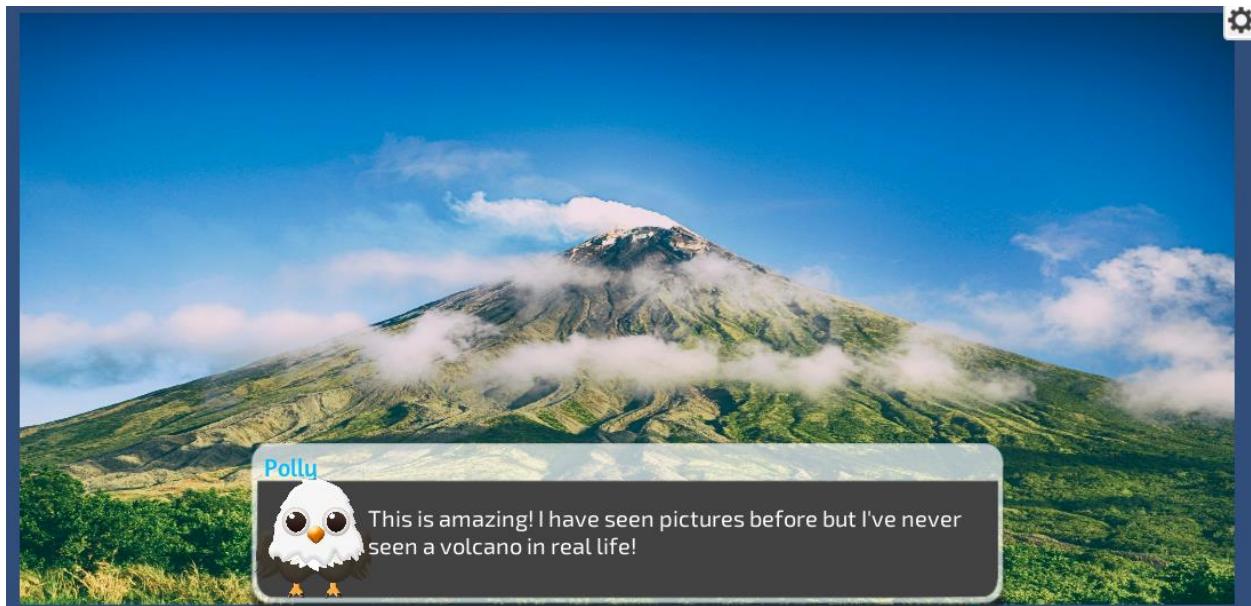


Figure 55. Screenshot of the Volcano, the last location players visit. Polly expresses amazement at the Volcano.

She sees Grandpa and the pair run over. A sprite of Grandpa appears as Polly exclaims that they have not seen him for some time.



Figure 56. Screenshot showing Grandpa's sprite as Polly exclaims that the pair have not seen him in a long time.

Grandpa says that he's glad that the pair followed him and asks if they have learnt anything. Polly tells him about the places they have visited and Grandpa expresses surprise about the visit to space. He then asks what they have learnt about English.



Figure 57. Screenshot of Grandpa asking the player and Polly what they have learnt about the English language.

Polly then explains what they have learnt.

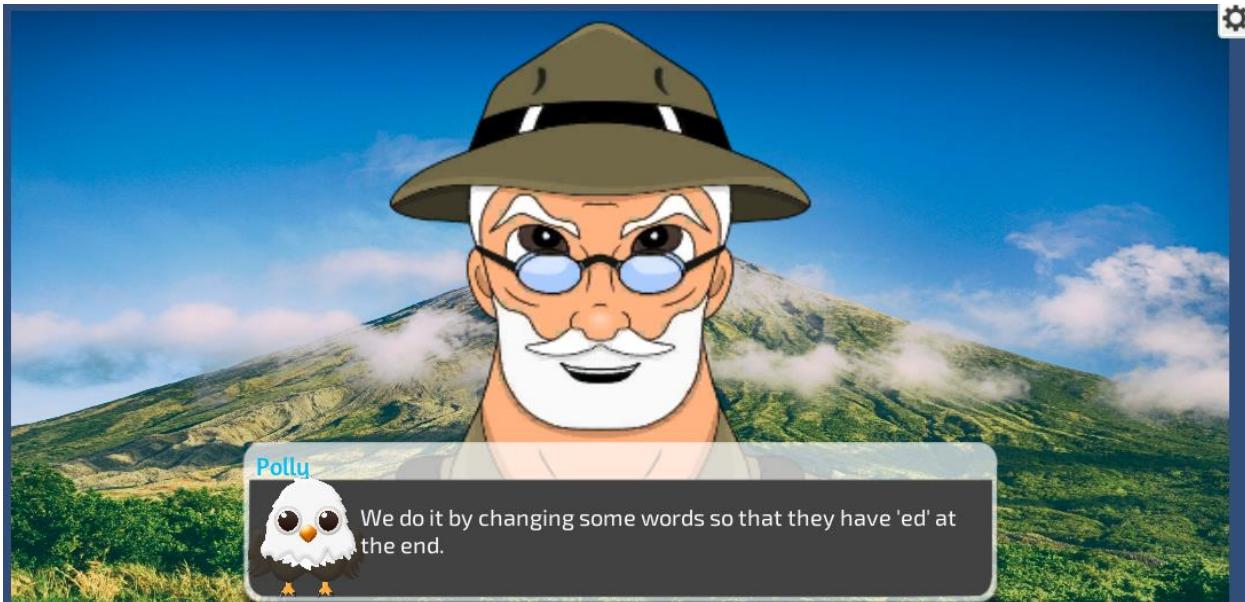


Figure 58. Screenshots showing a) The main topic that was learnt and b) how the player and Polly managed to talk about the past.

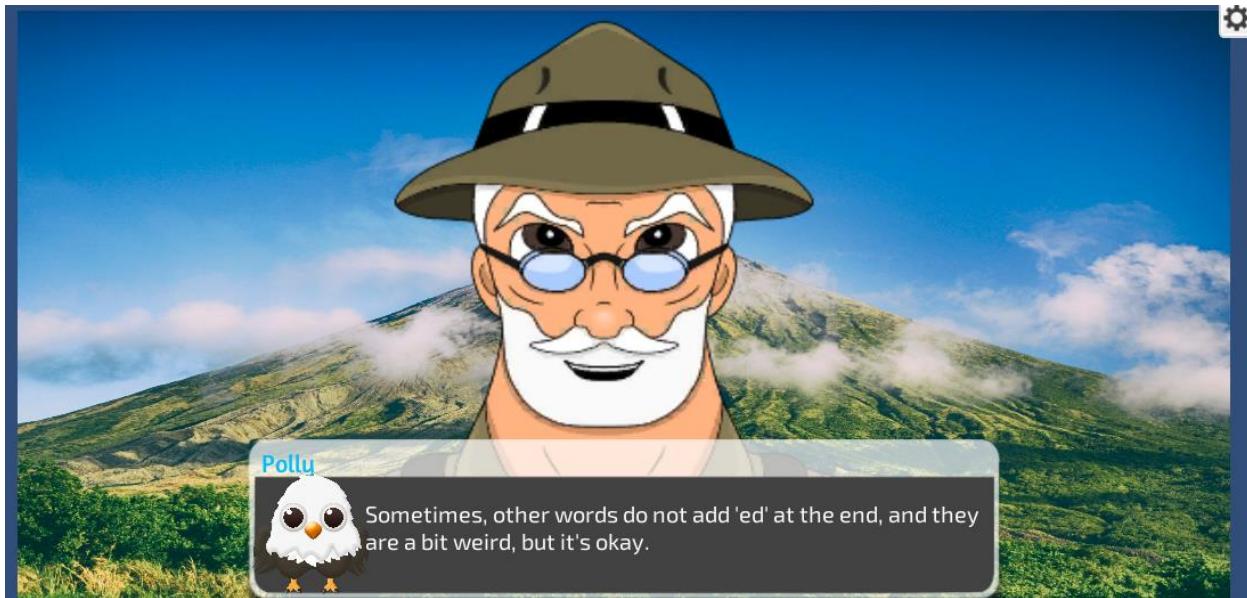


Figure 59. Screenshot of Polly warning against the overgeneralisation of the 'ed' rule used to identify past tense words.

Grandpa replies saying 'that's good' and that he himself has been on many adventures. Polly asks him to tell them what happened, but Grandpa instead says that he will tell them later. Instead, he suggests staying there a bit longer before going home, where he will tell them his story. Polly agrees, and says that his Grandchild, the player, has been very helpful in finding him. Grandpa says that 'you', referring to the player, will grow up to be a smart person.

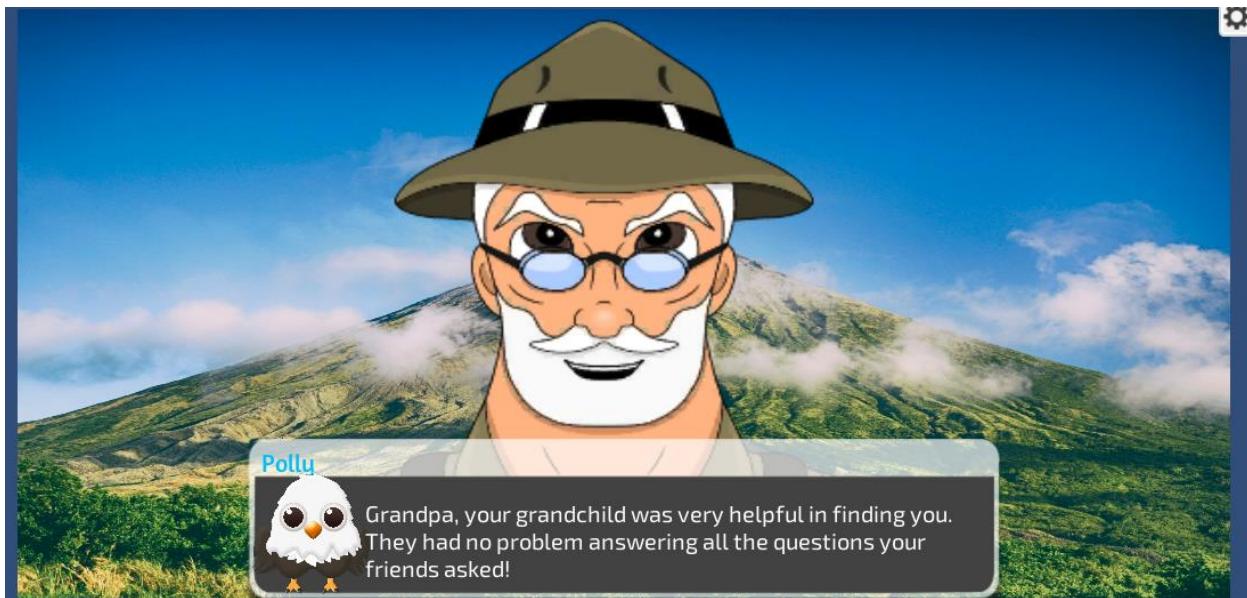


Figure 60. Screenshot of Polly praising the player to Grandpa.

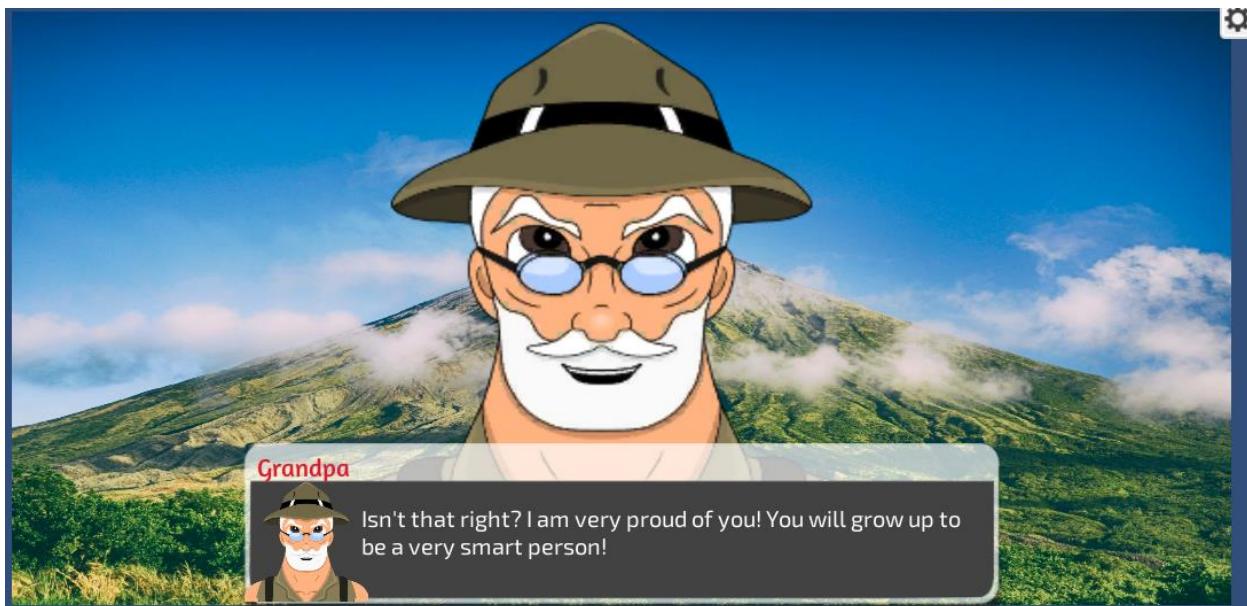


Figure 61. Screenshot of Grandpa saying that 'you', referring to the player, will grow up to be a very smart 'person'.

He then says that for now, they should appreciate the scenery. The dialogue box disappears, and the background lingers for 3 seconds before fading to the main menu screen.

Appendix H: Storyboard of the sub-plot of ‘Where’s Grandpa?’

After choosing ‘Play Grandpa’s Story’, the game starts in the living room with Grandpa, who the player embodies in first person view, saying ‘what a beautiful day!’ and wondering how his grandchild is doing.

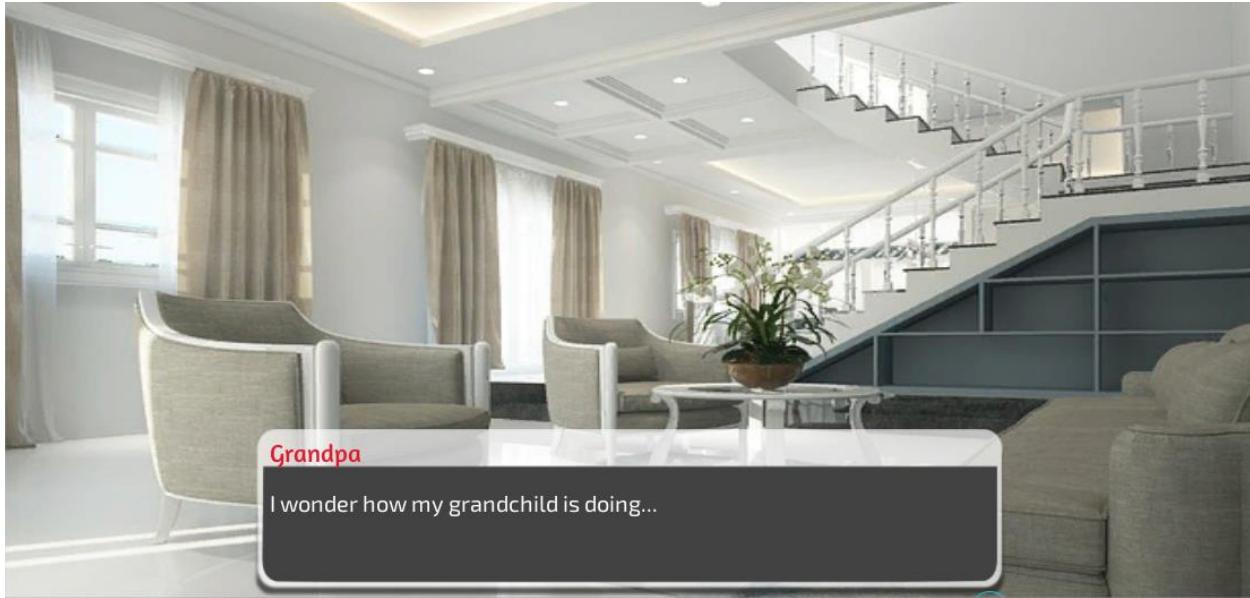


Figure 62. Screenshot showing the player, as Grandpa, in first person view wondering how his grandchild is doing.

He calls for Polly, who shouts that they’re upstairs. Grandpa asks how his grandchild is doing, after which Polly replies that they’re sleeping.

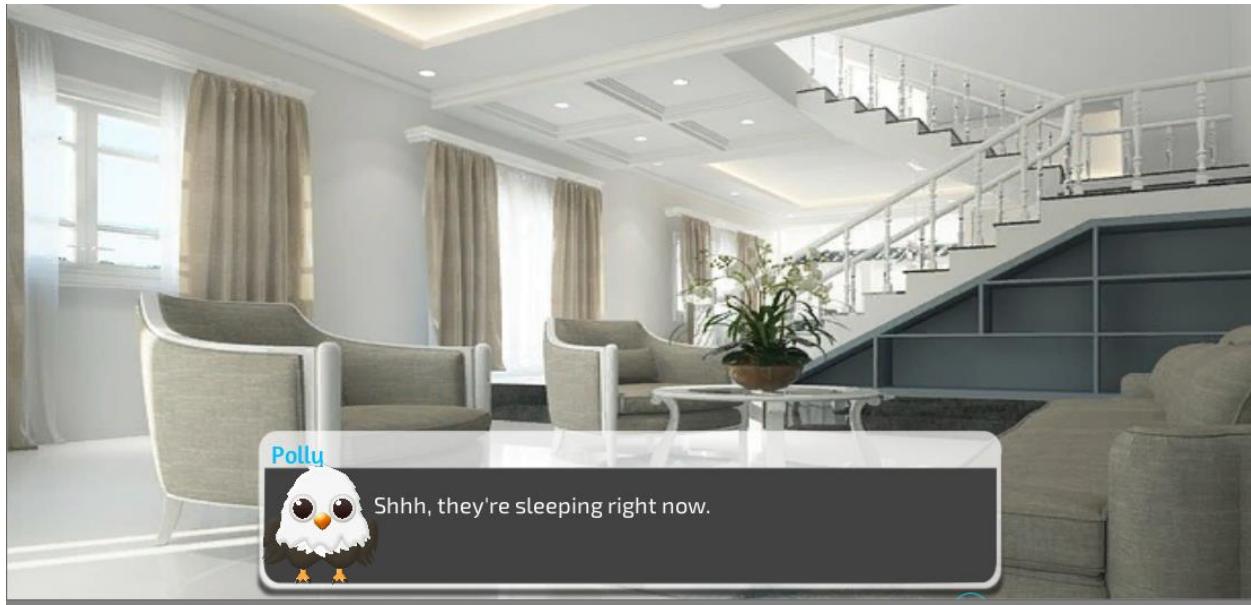


Figure 63. Screenshot of Polly saying that the Grandchild is sleeping.

Grandpa says that he will visit his friends and explore. Polly's sprite appears, and asks where Grandpa will be going. Grandpa replies that he will go for a walk and 'see the animals'.



Figure 64. Screenshot of Grandpa explaining what he will do to pass the time.

Grandpa suggests that they make the trip a game. Polly says that it's 'so like [him]' and that 'they're so fun!' Grandpa says that he will 'use the travel machine'. Polly exclaims that they have not used it since 'papa and mama went on their business trip!'



Figure 65. Screenshot of Polly expressing surprise at Grandpa's plans to use the travel machine.

Polly agrees to the game, and Grandpa goes off to the zoo. The screen fades and transitions over to the zoo. Grandpa says that he has not been to the zoo for 5 years. He calls for the zookeeper, who promptly appears.

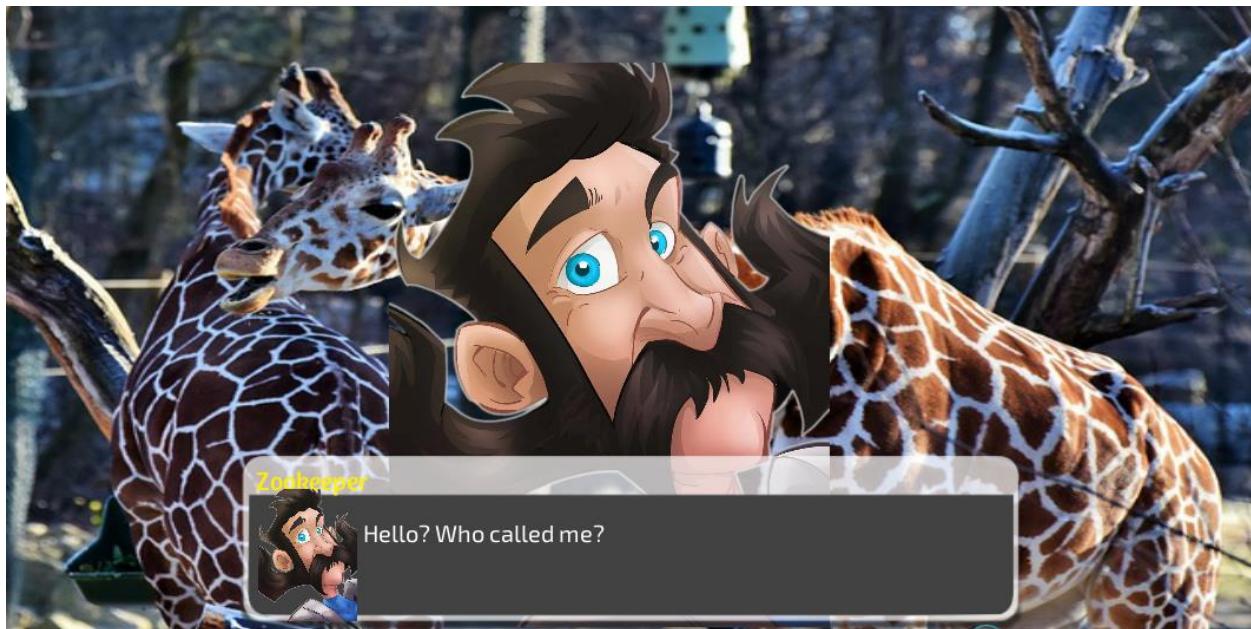


Figure 66. Screenshot of the Zookeeper appearing, wondering who called his name.

The Zookeeper greets Grandpa and asks where Polly is. Grandpa replies that he has been watching his grandchild and that they (his grandchild) is doing fine.

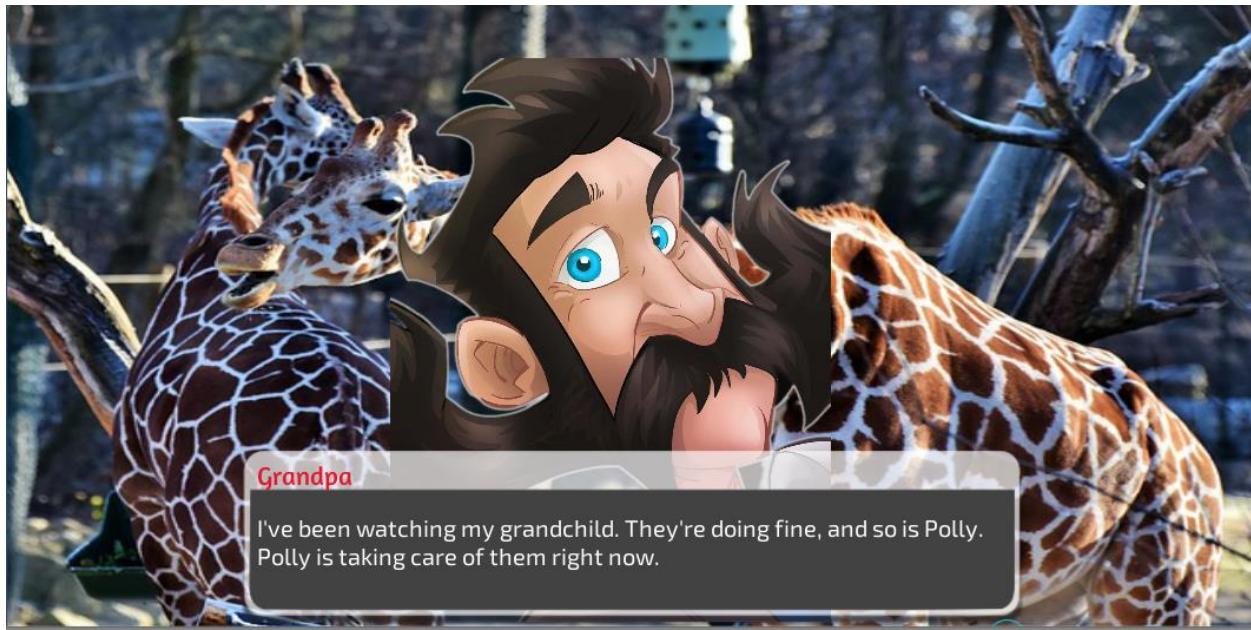


Figure 67. Screenshot of Grandpa explaining what he has been doing and what Polly is doing to the Zookeeper.

Grandpa says that his grandchild and Polly will be at the zoo soon, and that he wants to play a game with them. The zookeeper asks what kind of game he wants to play. Grandpa replies.

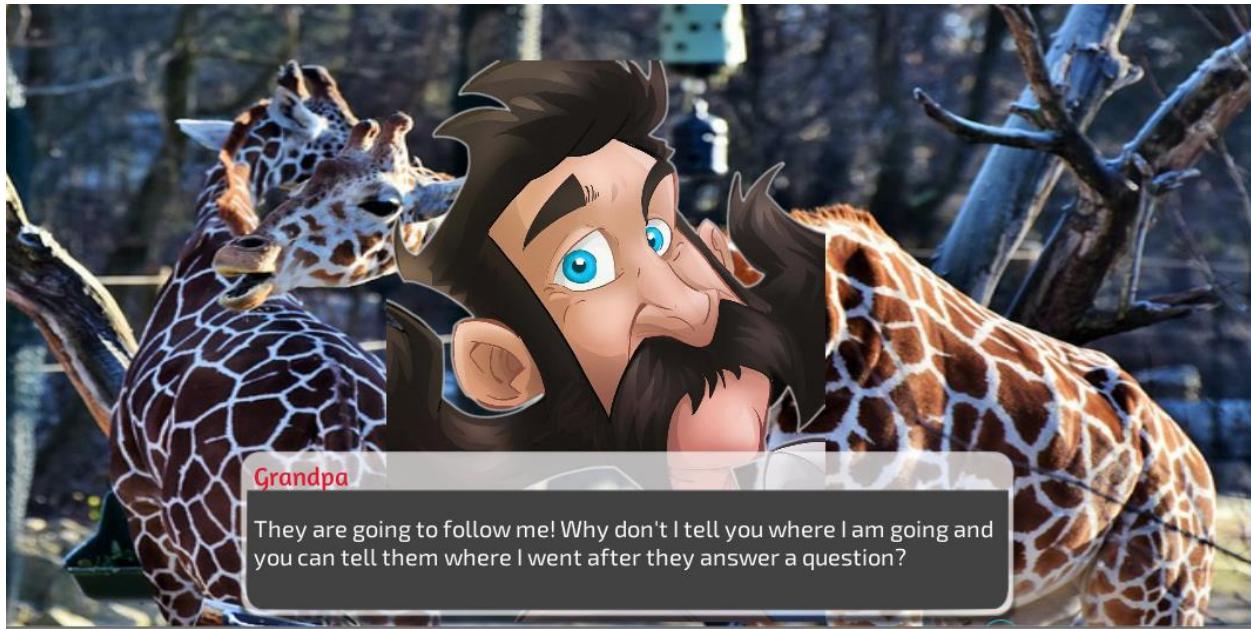


Figure 68. Screenshot of Grandpa setting up the game that the Grandchild and Polly will play in the Main Story.

The Zookeeper asks what kind of question he should ask.

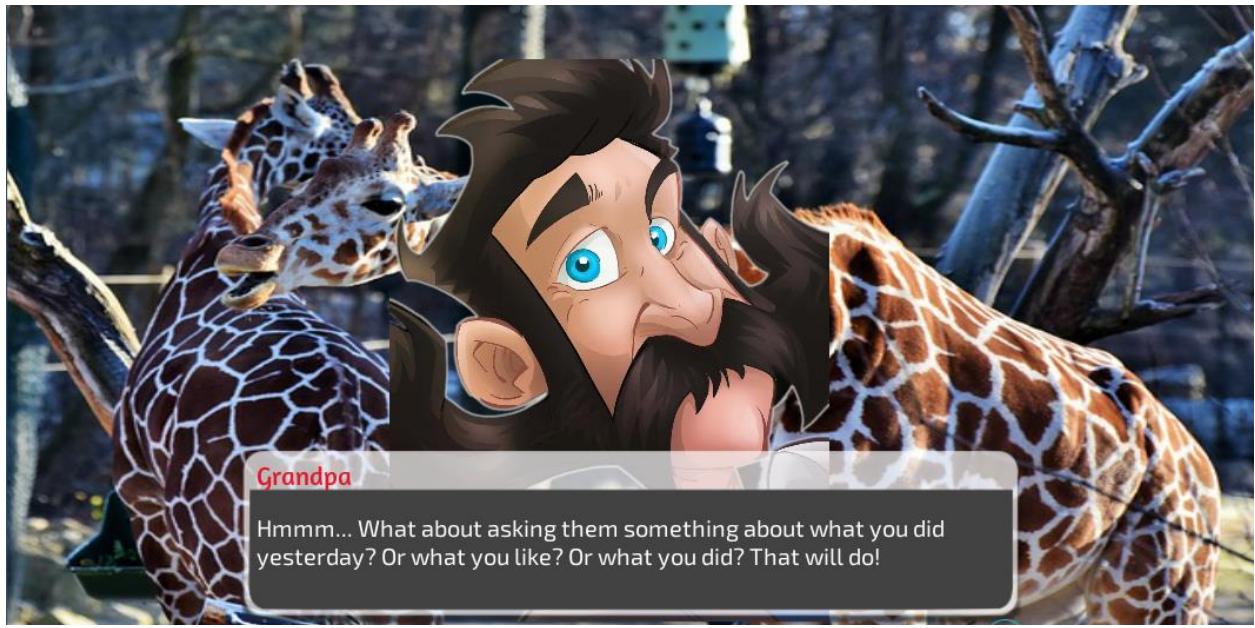


Figure 69. Screenshot of Grandpa suggesting what kind of questions the Zookeeper can ask.

The Zookeeper says that he can do that. Grandpa is glad and wants to take the time they have to talk. The dialogue box then says 'And so, Grandpa and the Zookeeper talked.' It continues with 'Grandpa would then go to the park and the train station to meet the Park Ranger and the Station Master.' 'He would never meet the alien. But he did decide to visit a volcano, because he had never seen one before!'

It ends with 'Thank you for playing this game!'

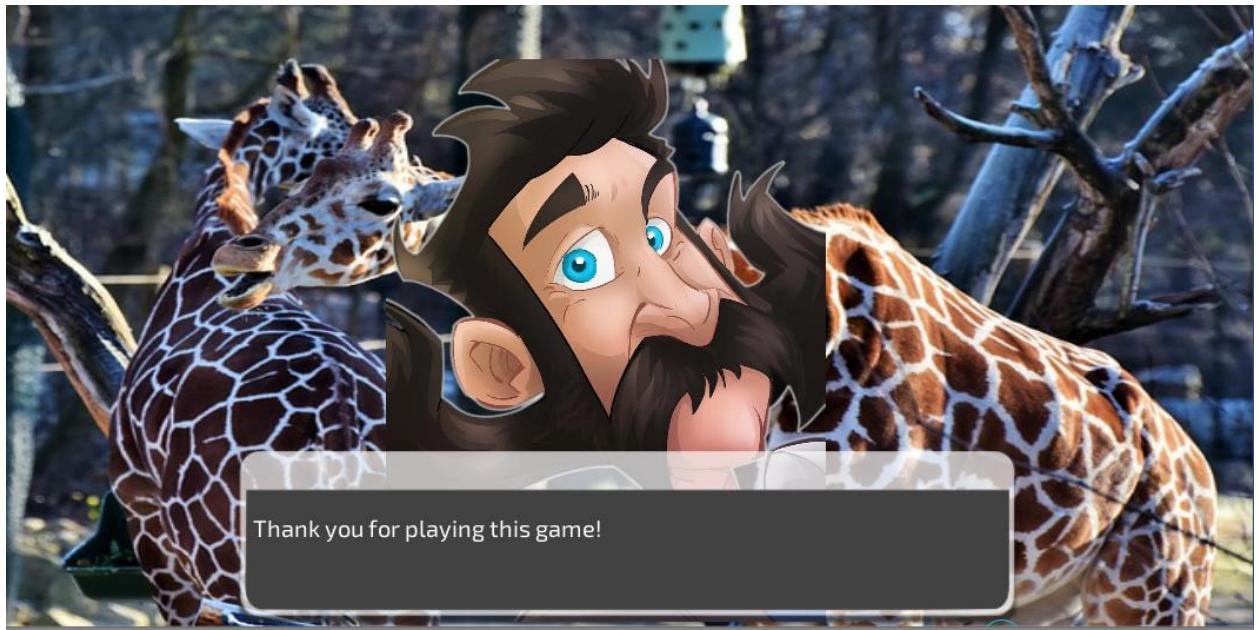


Figure 70. Screenshot of the narrator thanking the player for playing the game up to the end.