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## Writing with Alice the Virtual Peer

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**Abstract:** Sharing stories is an entertaining and learning activity for people, especially children. Most children, however, find it more challenging to put down their stories on paper. When a child encounters difficulty during story writing, a virtual peer can mimic the support given by a human teacher or peer, by facilitating the process through asking questions, giving directives, and even recommending possible story text to move the story forward. In this paper, we describe how the aforementioned tasks are achieved by our software agent Alice, using a combination of computational text understanding and generation techniques. Test results showed that children found Alice's prompts to be useful in situations when they were having a hard time writing their story and they would want to be given more options of how their story may progress. Furthermore, those who opted to include Alice's suggestions did so because these stated facts that add new details to their story.

**Key Words:** story writing, virtual peer, text understanding, text generation

### 1. INTRODUCTION

Writing stories is a task that children may be required to do in school. They may also voluntarily write during their free time. This is essential for them to express their experiences and observations, develop their imaginative skills, organize their thoughts, and use written language to communicate with others [1]. But writing stories is not as fun as its verbal counterpart, and may even be challenging to most children.

In recent years, technology has gained widespread use in the teaching and learning process. Productivity tools like word processors and presentation makers support the development of various forms of documents and reports needed in learning. Internet technology paved the way for alternative digital-based collaboration through learning management platforms and social network sites that enable educators and learners to exchange resources and to conduct discussions online. Graphical technologies and devices further enhanced the learning process through interactive and entertaining learning environments.

The most promising technology of all would be the integration of artificial intelligence (AI) into everyday computer software and devices. Through virtual agents that embody some form of human intelligence, researchers in AI have been able to develop software programs that can compete with human players in games such as chess (IBM Deep Blue) and Jeopardy (IBM Watson). Virtual agents have also assisted shoppers in finding items online, as well as addressed booking concerns of customers in online reservation systems.

But virtual agents can be more than just players and assistants. They can act as computer tutors to provide canned and sometimes personalized interventions to learners in intelligent tutoring systems [2]. In

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health care, software agents have been designed to support the inclusion of people with special needs, from speech to hearing impairments, to challenges in communication, social interaction [3], language and literacy development, mobility and daily living.

A virtual agent, also known as a software agent or a virtual peer, is a piece of computer software that has been designed to mimic various human capabilities and attributes. It can be a pedagogical agent that serves the role of a tutor, facilitator, learning companion, playmate, coach or critic. A virtual peer communicates with the human user through different modalities and interfaces, including written text or spoken dialogues, facial expression, and body gestures. It can also promote creative collaboration with the user through social engagements and communication, which are vital in literacy learning [4], vocabulary and language development [5], reasoning [6], and and critical thinking.

In this paper, we describe our virtual agent, Alice, and how it helps a child through the story writing process. Section 2 gives a brief overview of stories and story writing that guided the design of Alice. Section 3 then describes the process of collaboratively writing a story with Alice, including the virtual peer's ability to identify story elements and to generate appropriate responses. Section 4 presents our findings with sample story text that were written by children with Alice. The paper ends with a summary and recommendations on further enhancing the capabilities of the virtual peer.

## 2. STORIES AND STORY WRITING

Sharing stories with peers is a fun activity for children. Not only does storytelling hone their literacy skills, but also nurtures children's oral and written communication as well. Before software agents that share stories with children can be built, there is a need to first understand the elements and structure of a story, and the techniques employed by human tutors in teaching the art of story writing. The various roles that a peer, whether human or virtual, may play in the context of shared storytelling should also be identified.

### *2.1 Elements and Structure of a Story*

A story has three main elements, namely the character, the setting and the plot. The character is the doer of actions that take place in the story world, and may respond to events. He/She interacts with the environment comprising of other characters and objects. As the story unfolds, the character encounters one or more problems and tries to find ways to resolve these. The main character, the protagonist, plays the central role in all events in the story. An antagonist who opposes the main character may or may not be present. Secondary characters may also exist to act as companions of the protagonist or the antagonist.

The setting is the backdrop of the story world where the character actions and story events will be played out. It includes the location and the time when the story will take place, and optionally the weather conditions and the social conditions to create the mood of the story.

The plot is the sequence of events that takes place in the story. Though typically containing five parts, namely the introduction, rising action, climax, falling action and denouement; for this research, the three-act structure [7] typically used in screenwriting will be followed instead.

In the three-act structure, a story is divided into the beginning, the middle and the end parts. The beginning part describes the setup of the story, where the characters and the setting are introduced. The conflict may also be revealed at this stage. The middle part of a story is the rising action. It contains the confrontation involving the participation of the protagonist in a series of events that may lead him/her to the resolution of the conflict. The end part is the climax. It acts as the resolution of the conflict and shows the state of the character, wherein he/she may succeed or fail in reaching his/her goal to solve the conflict.

Every story has a conflict [8]. It is the problem faced by the characters that creates tension and makes the plot move forward. This opposition may be actual or perceived, and may involve one's needs, values and interests [9]. A conflict can be between man and another man, man and his/her struggle against a life circumstance, man against society, and man vs himself/herself.



## 2.2 Writing Stories

Storytelling is "the conveying of events in words ... as a means of entertainment, education, preservation of culture and in order to instill moral values" [9]. Our research focuses on the written form of storytelling, or story writing. Whereas oral storytelling abstracts details from the hearers to make them imagine the physical attributes of the different elements in the story, written storytelling tends to be exhaustive in details and is dependent on how the reader interprets the message conveyed by the author.

Two major reasons why children cannot meet the demands of classroom writing are their difficulty in generating text [10], and their lack of knowledge about writing and the writing process [11]. These lead to compositions that are brief, and lack detail and elaborations [12].

Teachers utilize different techniques and follow a series of stages of writing to enhance story writing among school children. In the *pre-writing* stage, children are taught to use a story map to organize their ideas, to determine the elements that comprise the story, and to help familiarize them by identifying its three parts.

Teachers may use themes as the writing prompt, to give children a certain topic to write about. A theme is the central idea that the story writer may want to impart to his/her reader. Story themes for children usually revolve around everyday experiences to prepare them for events that they may encounter in their lives. Though themes are not mandatory as these may pressure the children to write about something they are not familiar with, teachers usually encourage children to recount their experiences or interests, since it is easier for children to chronicle events that they experienced firsthand.

Teachers may also assist by suggesting different details. These may be in the form of questions that prompt the child to expound on a story element, for example, to identify the character, to describe the object or the location, or to explain the cause and effect of an event. A suggestion may also be in the form of a story text to continue the plot when a child is experiencing a writer's block.

## 2.3 Role of Peers in Storytelling

The zone of proximal development defined by Vygotsky [13] stated that a child can perform at a higher level of development if learning is done with a knowledgeable peer. In storytelling, this peer can be a teacher, a parent or guardian, a sibling, or a friend who has the same developmental age. Different kinds of conversations take place between children and their peers, from exchanging information, to teaching proper behaviors, socializing, and expressing feelings [14].

In computing, a virtual agent has the goal of "stimulating the student's learning through collaboration, competition and demonstration" [15]. To achieve this, the agent can serve the role of (1) a peer who collaborates on the task; (2) a guide who shows the student around the virtual learning environment, gives alerts on new events, and assists in navigating through the course materials; (3) a coach who gives instructions on how to use the different tools in the learning environment; and (4) a tutor who monitors performance and gives timely explanation and feedback.

In this research, the virtual agent primarily serves the role of a peer. Collaboration in this sense is defined as working together in performing the writing task, or co-authoring a story. A collaborative peer can suggest ideas as well as encourage the child to tell more about the story. The peer and the child can also take turns in doing the task.

## 3. ALICE THE VIRTUAL PEER

Alice is a software agent that can collaborate with children by contributing more information about the elements and events present in the story. It assumes two roles - as a facilitator, Alice gives prompts for the child to ponder on and helps the latter to think of ideas on how to expand his/her story; and as a collaborator, the peer suggests new sentences to continue the child's story.

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At the start of a writing session, the child (user) is given two writing modes to choose from - the *beginner* mode and the *advanced* mode, as shown in Fig. 1. In the beginner mode, the linear structure of a story is required to be followed. In the beginning part, the character, location and conflict must be present. In the middle part, there must be a sequence of at least two actions or events that have happened. In the end part, there must be a resolution. A to-do list or checklist (see Fig. 2) is used to serve as a reminder about these story elements that must be present. Each element also includes a description and an example sentence to further guide the writer, as shown in Fig. 3. This feature of Alice is aligned with the strategy employed by human teachers to help familiarize the child with the different parts of a story.

On the other hand, free-form writing can take place in the advanced mode (shown in Fig. 4), relieving the user from having to follow the linear story structure.

Fig. 1. Choose writing modes

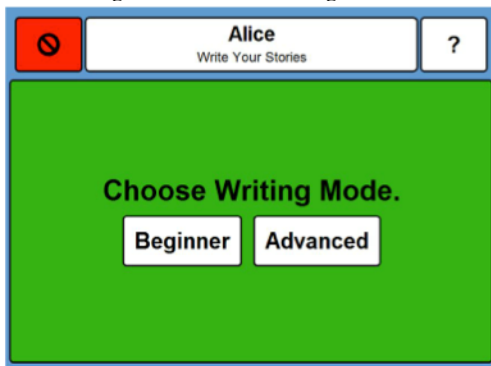


Fig. 2. Checklist for the different parts of a story

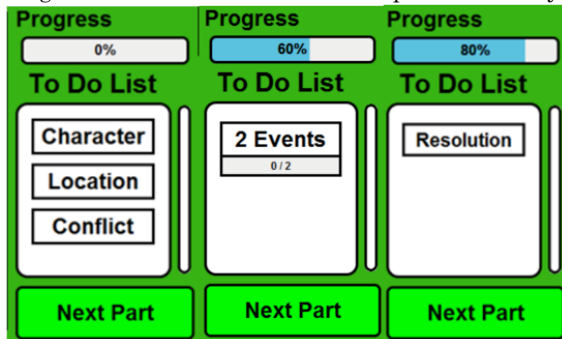


Fig. 3. Description of story elements

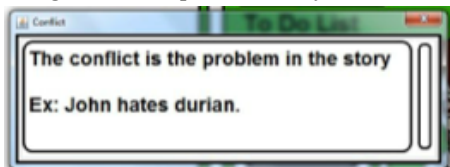


Fig. 5. Story writing in the Beginner mode



Fig. 4. Advanced mode

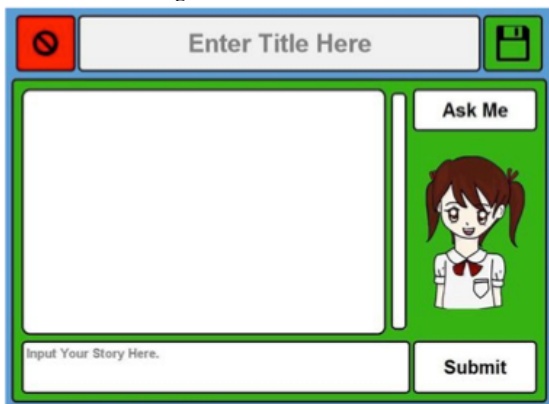
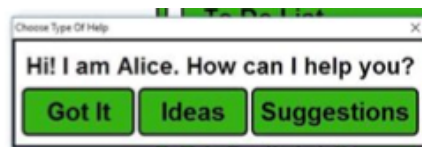


Fig. 6. Asking help from Alice



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The collaborative writing session begins when the user enters a story text, which can be comprised of a single sentence or multiple sentences. Using Stanford CoreNLP [16] which is a software tool that performs tokenization, part of speech tagging, named entity recognition, co-referencing and semantic role labelling, Alice then identifies the nouns that may represent characters, objects and locations; verbs that represent actions; and adjectives. The to-do list and the progress bar are updated accordingly, as shown in Fig. 5.

Stories are made more interesting if the writer imparts details about the characters, objects, location and events taking place in the story. For Alice to help the writer do so, it must be able to plan its response when the writer asks for guidance through the "Ask Me" option (see Fig. 6). The "Ideas" option leads Alice to generate prompts that guide a user on the type of details that he/she may write about for a given character, object, location or event. The "Suggestions" option, on the other hand, tasks Alice to write a story text.

During planning, Alice identifies a list of candidate nouns from the writer's input story text that will be the focus of its prompt or suggested sentence. Alice also looks at the verbs to ascertain if an event or an action has missing details, e.g., location, direct object or receiver of the action.

Prompts are imperative sentences that focus on the characteristics of a selected noun or verb. Consider the input sentence "There is a girl named Lexine." as written by one of the participants during the end-user testing of Alice. A request for ideas prodded Alice to prompt: "Tell me more about Lexine." The user responded to the prompt with the text "She lives in a big house.". A prompt may be stated in various forms, as shown in Listing 1.

Listing 1.

User's input:	There is a boy named Ben.
Alice's prompt:	Tell me more about the boy.
Alice's prompt:	Describe the boy.
User's input:	Ben likes reading books.

Listing 2.

User's input:	A day is a time period.
Alice's prompt:	I want to hear more about the time period.
Alice's prompt:	Describe the time period.
Alice's prompt:	Tell me more about the time period.

Listing 2 shows sample prompts for the noun "time". In this instance, however, the child was not able to give any answers despite differing restatements from Alice. Prompts may also be presented as interrogative sentences. These prompts are usually used in the middle and end parts of a story to cater to object and event descriptions, and causal effect of events. Examples of interrogative prompts are found in Listing 3.

Listing 3.

User's input:	Harry lives in the cupboard under the stairs. One day, Dudley woke him up. Dudley is obese and spoiled.
Alice's prompt:	What is the nationality of Dudley?
Alice's prompt:	What is the attitude of Dudley?
Alice's prompt:	An example of attitude is serious. What is the attitude of Dudley?

Listing 4.

User's input:	Kevin's car can be fun.
Alice's story:	Kevin's car is a vehicle.
Alice's story:	Kevin's car has an engine.
Alice's story:	Kevin's car is a mechanical device.
Alice's story:	Kevin's car can be expensive.

Alice may also suggest descriptive sentences that the user can opt to add to his/her story, as presented in Listing 4. These descriptions may give details about an object's class (*is a*), components (*has a*), attributes (*can be*), location (*is in*), usage (*used for*) and causal properties (*produces, became*). To achieve this, a knowledge base containing concepts about everyday things and their relationships was built to provide Alice with some form of commonsense knowledge about our world. This knowledge base is then populated with relevant assertions that were extracted from ConceptNet [17] and children's story books, such as *isA(car, vehicle)*, *partOf(car, engine)*, *isA(car, mechanical device)*, *propertyOf(car, expensive)*.

This same knowledge base is used by Alice to describe any of the nouns found in the user's input, as shown in Listing 5. Because of Alice's heavy reliance on this knowledge base of concepts, it is not surprising that we encounter situations wherein the virtual agent may either run out of ideas on what to write due to insufficient assertions (as illustrated in Listing 6), or gives too many explicit suggestions such as "Hannah is a person." due to excessive assertions. This is similar to the problems encountered by story generation systems that rely on a large body of input corpus to do their tasks, as reported in [18]. Listing 6 also exemplifies an instance wherein Alice misinterpreted the input text due to the child's misspelling of the word *also* with *olso*.

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Listing 5.

User's input:	Gabriela wants to go to Mcdo. She wants to eat rice and chicken at McDo.
Alice's story:	A chicken is in a farm.
Alice's story:	A rice can be white.
Alice's story:	A chicken can be delicious.

Listing 6.

User's input:	Jonah <u>also</u> has a big beard.
Alice's story:	Jonah also's beard is a rim.
Alice's story:	Jonah also's beard is a hair.
Alice's prompt:	What is the talent of Jonah also?
Alice's prompt:	I can't think of something.

Listing 7 is a sample shared story. The underlined texts are those suggested by Alice and which the user opted to add to his/her story. Note that this demonstrates how Alice chooses which entity to be the focus of its prompt and/or story text.

Listing 7.

Kevin is alive. Kevin has a car. Kevin's car can be a fun. Kevin's car can be expensive. Kevin's car is a Ferrari. It is color red. Kevin's friend is Bob. He loves his teddy bear. <Alice's prompt: Tell something more about Kevin's friend.> Bob is sad so Kevin brings out his clown costume. <Alice's prompt: Write more about Kevin.> Kevin wears a rainbow wig then he makes jokes to makes Bob laugh. Bob is now happy. They went to the mall. They play at tom's world.

In Alice, a conflict is defined as the story text that introduces negative emotion by containing a concept with the least negative polarity. This polarity is derived from SenticNet [19], a knowledge resource that associates a set of semantic concepts with their emotional values. In the given story in Listing 7, the conflict is found in the clause "Bob is sad..." and signals the completion of the beginning part.

The middle part should have a series of at least two events, denoted by the use of action verbs. In the given story, these verbs are *wears* and *makes*. *Be* verbs are not considered. The end part requires at least one of the characters who caused the conflict to experience the resolution through a story text that uses a concept with a positive emotion. Moreover, this resolution should also be related to the conflict. In this case, the resolution is in the sentence "Bob is now happy."

## 4. TEST RESULTS

End-user testing was conducted among 24 children between the age of seven to nine years old. Each child was asked to write a story with Alice. A debriefing was conducted to get feedback regarding the children's story writing experience. A log was also implemented to record the writings of the children as well as the actual responses generated by Alice.

Of the 17 participants in the first iteration of testing, 50% claimed that they were able to finish writing their stories. However, a review of the internal logs showed that none of them actually did. This is because Alice was unable to detect some of the story elements, as summarized in Table 1.

Table 1. Frequency of missing story elements

Missing Story Element	Frequency
Location	15
Conflict	11
Character	4
Resolution	17

These results were caused by the strict rules for detecting the presence of story elements. Alice does not associate a common noun as a possible story character. Each character mentioned in the story is also required to have an assigned location and a corresponding statement of an action done in the location. Thus, for the sentence "Her school is in Philippines.", neither the *school* nor the *Philippines* will be tagged as a location.



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In the case of the conflict, oftentimes, the participants wrote about their experiences without stating any concept that has a negative polarity value, as illustrated in Listing 8. For the singular participant that did make it to the end part of the story, the resolution was not recognized as such by Alice because it is not semantically related to the identified conflict.

Listing 8.

---

Gabriela went and roamed around SM. Gabriela bought clothes and notebooks. The notebooks are pretty. Gabriela ate at a restaurant. She ate fried chicken. It is yummy. She drank juice. The juice is RC. She played at SM. She played at the horses. The horses are pretty. She went to Jollibee. She rested. She rode a train. The train is beautiful. She went to Manila. She bought shoes. She went home.

---

During the second iteration, the restriction for the location was relaxed to enable the participants to easily meet this requirement. Most children also used a repeated theme of "the character *hates*", which not only has a negative sentic value, but is also easily resolved with a corresponding "the character *likes*" story text. Listing 9 shows an example.

Listing 9.

---

There is a boy named John. John went to Japan. John hates vegetables. John went to the festival. Then, he went to go in Valentines day. John likes now the vegetables because it's healthy.

---

Test results also showed that 91.7% of the participants asked Alice for help at least once, because i) *they were having a hard time in writing their story*; ii) *they want to know more options of how their story may happen*; and iii) *they find Alice's prompts and suggested story text amusing*. Those who did not ask for help justified by saying that they already have a story in mind, hence, they do not need the help of the peer.

33.3% of the participants did not find the prompts useful, due to Alice's tendency to repeatedly ask details for the same noun. This is caused by the requirement that a noun should have been mentioned at least three times in the story text, to ensure that all characters in the story are given importance. However, this restriction led Alice to select an incorrect noun for its prompt, as seen in Listing 10.

Listing 11 demonstrates an instance of a shared storytelling. For the story text suggested by Alice, 25% of the participants did not find these useful. Not only was Alice not able to suggest anything at times, but when it does, the story text contain grammatical errors and included concepts that were unfamiliar, too obvious and even made no sense to the children. Listing 12 exemplifies this.

Listing 10.

---

User's input: Once upon a time there was a rabbit who was having a tour around the forest and saw a house and he saw many potions and he wanted to touch it.  
 Alice's prompt: Tell something more about the time.

---

Listing 12.

---

User's input: Rosana has a car. They went to SM. They looked around SM. They shopped for clothes.  
 Alice's story: Rosana is an individual.  
 Rosana is a rock climbing.  
 Rosana is a family.  
 Rosana is a human.

---

Listing 11.

---

User's input: He like to play basketball.  
 Alice's prompt: Describe the basketball.  
 User's input: His favorite team is Golden State Warriors and his favorite place is Ocean park.  
 User's input: The church is in Singapore. And after that he went home. Ralph ask his father, daddy I went to church.  
 Alice's prompt: I want to hear more about boy's father.  
 User's input: Ralph's daddy is Eric.

---

Listing 13.

---

Suggested story text actually used by the children

- [1] Rosana has a car.
- [2] A chicken can be delicious.
- [3] A hamburger is a sandwich.
- [4] A teacher is an educator.
- [5] The prince is royalty.
- [6] Alice's dress can be blue.
- [7] A day is a time period.

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Of the 33.3% of the participants who found the suggested story text to be useful, 75% of them opted to append these suggestions to their stories because i) *they cannot think of anything to write*; ii) *the suggested story text stated a fact*; and iii) *the suggested story text gave a new detail to their story*. Examples of these are enumerated in Listing 13. One participant even expanded on the story text suggested by Alice, as illustrated in Listing 14.

Listing 14.

Alice's story:	Japan is an island.
User's input:	Japan is island lying off the coast of Asia.

Professors of creative writing provided qualitative evaluation of the linguistic aspect of Alice's prompts and suggested story text, using the logs of the writing sessions. Because these professors were consulted during the design of the templates used by Alice to generate prompts, the evaluators found the prompts to be comprehensible by the target age group. Concern, however, is on the generality of the prompts, as observed from the logs where the children encountered difficulty in responding to some of the prompts, causing them to repeatedly ask for another prompt without acknowledging the previous one.

The evaluators gave different suggestions on improving the prompts. First, the tone of the prompt should be more personal by using a "me" pronoun, e.g., "Tell me something more about <noun>.". Second, generate prompts that will lead to a possible conflict for the protagonist. Third, consider prompts that may encourage the child to write dialogues for the story characters, as dialogues can be essential in eliminating parts of a story.

The evaluators also pointed out the presence of numerous grammar errors in the stories, some of which are from the children while others are from Alice. Missing or inappropriate use of pronouns and articles also occurred in the shared stories, as shown in Table 2.

Table 2. Examples of missing or inappropriate use of pronouns and articles (underlined)

Error type	Incorrect instance
Missing article	I want to hear more about <u>the</u> boy's father.
Missing article and pronoun	Tell <u>me</u> something more about <u>the</u> boy's day.
Missing pronoun	I want to hear more about <u>her</u> mother.

A "wrong topic", as highlighted by the evaluators, occurs when Alice prompts the child to write about a noun that has no significant impact in the story. Instances of this are shown in Table 3.

Table 3. Examples of prompts on incorrect topic

Child's Story	Alice's Prompt
Once upon a time there was a shepherd boy who watched a herd of sheeps.	Describe the time.
she saw the children while Nanny was asking for help she introduced herself and her name was Lucy the big person and the children told her to open the window	Describe the window.
Once upon a time there is a baby tiger play with his friends and he became big now and he are wild and dangerous. And he killed his family and now he is in the zoo	I want to hear more about the family.

Inappropriate story segments that were generated by Alice were also indicated by the evaluators. Some of these are shown in Table 4.





Table 4. Examples of inappropriate story segments generated by Alice

Inappropriate	More Appropriate
Janella is a rock climbing	Janella went rock climbing
Japan is a lacquerware	Japan has a lacquerware
Janella is a family	Janella has family

## 5. CONCLUSIONS

According to Troia [20], among the three "Rs", writing is the most neglected, with teachers spending a bare minimum amount of time each week in teaching writing. Sharing stories through written text is one form of writing that children can do in the classroom to enhance their creativity while developing their language and composition skills. Just like in other areas of the curriculum, technology can play a role in addressing the challenge faced by students during a writing task.

In this research, we applied text understanding and text generation techniques to enable a virtual agent, Alice, to collaborate with a child while the latter is engaged in the story writing task. Specifically, Alice can support and assist children as authors by giving them space to practice language use through the writing of stories. Alice can also afford opportunities for each child to write at his/her own pace, to select his/her own topic of interest, and to work with a peer whose role is determined by the child himself/herself.

Alice is currently only able to address a few of the many challenges faced by children during a writing session. One of these challenges is identifying the topic to write about. Alice can be designed to utilize story starters or story prompts, which are "scenarios or statements that someone else has already come up with" [1]. These ready-made scripts for common themes or familiar events can give children an initial idea that they may expound on in their writing.

As seen in the sample story text written by children, numerous spelling and grammar errors abound. In this situation, Alice can assume a tutor role to correct spelling and grammar errors, as well as use this opportunity for vocabulary enrichment by suggesting various synonyms, using advanced words in its suggested story text, and defining differences among lexical choices. The text generation module of Alice itself should be modified to reduce if not eliminate grammar errors from its responses.

The knowledge base of Alice should also be expanded to enable it to generate better and more varied responses. These include helping the child in building the story character, describing the setting, and organizing the sequence of events. Prompts, for example, may focus on asking the child to detail how characters move from one place to another, to specify how much time has passed between two events, or even to help the child think about the dialogue that a character may utter in lieu of narrating a story element.

## 6. ACKNOWLEDGMENTS

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