

**EXPLORING THE XO LAPTOP  
AS A PLATFORM FOR ENCOURAGING  
CREATIVE WRITING BY CHILDREN**

by

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A thesis submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Honors Bachelor of Science in Computer Science with Distinction

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2012 Austin Cory Bart

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## **ABSTRACT**

Creative Writing is an important expression of creativity, and there currently exists no satisfactory Learning Software for the widely-distributed XO Laptop Platform to fill this niche. This study created two new Creative Writing Learning Activities for the XO Laptop and intervened in a classroom to test their effect on the Intrinsic Motivation of children to write creatively using the XO laptop. The quantitative and qualitative results indicate that children were motivated to write using the software, leading the way to further improvements to the software for future benefit.

# Chapter 1

## INTRODUCTION AND BACKGROUND

Creativity is perhaps the most important ability that humans possess and is a core element of almost every discipline; one of the most pure expressions of creativity is in writing. Creative writing has such an important role in creative development that writing ficitonal narratives is an explicit primary objective in the K-12 Common Core Standards in English Language Arts across different grade levels[6] (detailed in Table 1). Like any other of teachable subject, creative writing can be supplemented by technology through Learning Software[30] [23].

**Creative Writing** Original composition that primarily conveys emotions, thoughts, and feelings instead of information.

**Learning Software** Computer software designed for teaching or self-learning.

### 1.1 Creative Writing and the Role of Software

Computers, in general, have been found to be a very effective tool for beginning writers (such as children), allowing them to write more neatly and make corrections

**Table 1.1:** State Standards for English Language Arts and Literacy in Grades 4 and 8

Common Core State Standards for English Language Arts	
Grade 4	Grade 8
Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.	Write narratives to develop real or imagined experiences or events using effective technique, relevant descriptive details, and well-structured event sequences.

more easily[5]. Tools such as text-to-speech feedback can help by increasing the amount of time that children spend editing[2], although this does not have a significant effect on the length or quality of the users' writing[5]. Spelling and grammar checking software can also provide useful and immediate feedback on childrens' ability to write correctly and coherently.

**Text-to-Speech** Software designed to translate text into human speech.

Text-to-speech software and spelling and grammar checkers are software that can be more or less fully automated; neither requires a human to perform the evaluation. However, evaluating users' creativity cannot be automated with the present level of technology. Therefore, Learning Software specifically for Creative Writing is usually designed as an open-ended, story-telling environment meant to encourage students to write[13], rather than to evaluate their creative ability[4].

In order to measure how Creative Writing Learning Software encourages children to write, we use Cognitive Evaluation Theory (CET), which concerns Intrinsic Motivation[8].

**Intrinsic Motivation** Motivation based on taking pleasure in an activity rather working towards an external reward[8].

Cognitive Evaluation Theory dictates that the Intrinsic Motivation of a child is affected by three broad facets[31].

1. Perceived Competence: how much they believe that they have the skill to be effective in achieving their goals.
2. Autonomy: how much they perceive their results to be attributable to factors under their control.
3. Interest: how interested they are in the topic.

For this project, three design principles corresponding to these facets were created in order to evaluate learning software's success in increasing Intrinsic Motivation.

1. Simple: The software should be simple and foster a feeling of competency in the user.
2. Expressive: The software should be expressive so that users can do what they want.

3. Enticing: The software should be interesting so that users want to keep using it.

Besides these overarching, primary design principles motivated by Cognitive Evaluation Theory and formed explicitly for this project, work has been done by Gelderblom to establish design principles for creative writing learning software[13] and for learning software in general. Other sources have also been tapped to add an additional Design Principle, Multimedia. The most salient principles by Gelderblom and the additional Multimedia principle are summarized below, and are to be considered secondary principles:

- Inspirational: The software should be Expressive, but should not require the user to create stories completely from scratch. For example, it could include a text bank of ideas and suggestions in order to provide inspiration and “starting points”, or rich graphical elements.
- Organizational: The software should include external and internal mechanisms to improve the organization of the user’s story. The software should include mechanisms to read and modify existing stories and sequence jumbled stories.
- Modal: The software should have clear and distinct use cases for “editing” and “acting” (observing) a story. This can greatly supplement the review process of a story.
- Supportive: The software should include a training module with a software agent who can support the child (but does not criticize or correct) and other supportive elements such as text-to-speech technology and spelling and grammar support.
- Juxtapositional: The software should juxtaposition diverse elements, especially realistic and imaginative props, scenes, characters, etc. to help relax, interest, and inspire users. Children do not require a high degree of realism, and can be greatly inspired by the combination of fantasy and realistic elements.
- Collaborative: The software should encourage students to subtly and naturally work together; Gelderblom points out that “the enhanced effect of collaboration versus [the] lesser effect of individual use should be clearly noticable in advance.
- Multimedia: The software should involve some synthesis of as many of the following as is possible and reasonable: text, audio, graphical, and animation. Work by Liu et al and many other sources has shown Multimedia to be an effective addition to learning software[20].

## 1.2 One-Laptop-Per-Child and the XO Laptop

The One-Laptop-Per-Child project was founded in 2005 with the ambitious intent of ending the Global Digital Divide[27] by providing rugged, low-cost, low-power,

**Figure 1.1: XO Distribution**



Blue: 5000+ (Saturation)  
Bottom: <5000

connected laptops (the “XO Laptop”) to children across the world[27]. Its success in ending the Divide has been questioned [48] [7], but the scope of it’s distribution is inarguable. As of November 2011, there are 2.4 million XO’s[27] in over 40 countries. It is estimated that 1 in 20 children in Latin America have an XO laptop[51], and in some places the ratio has become fully 1:1. As figure 1.1 demonstrates, the XO is unquestionably widely distributed among children over the world.

Amazingly, only within the past year has the OLPC foundation really started investing in empirical research with the laptops[47]. There have been a number of usability studies performed on the effectiveness of the innovative Sugar User Interface that was created in parallel with the hardware[18][25][44].

**Sugar User Interface** An open-source desktop environment designed for the XO Laptop. The unique design of the environment does not use the traditional “desktop”, “folder”, and “window” metaphors. Instead the environment emphasizes the metaphors of “Activities”, which run at full-screen to emphasize discrete, asynchronized actions, and the “Journal”, a non-hierarchical collection of files. [40]

**Learning Activities** Learning Software that is designed for the XO laptop.

However, very little research has focused on the effectiveness of the learning software running on these laptops[21], even though much of the software for the XO has been custom-written. It is critically important for the future development of this platform that effective software be developed, analyzed and improved in order to enhance its effectiveness as a learning tool for children.

### **1.3 XO Laptop Software Development**

Currently, the official Sugar Activity Library has roughly 400 downloadable Learning Activities of highly varying quality[39]. Some of these games are already available natively on the XO, but most were written by 3rd parties and have inconsistent developer support. Compared to common Operating Systems like Linux and Windows, the amount of software immediately available for the XO is incredibly small.

There are several reasons for this lack of available learning software. First, the XO is still a relatively unknown initiative, compared to platforms such as Windows and Linux. Second, writing new software can be difficult given the physical limitations of the hardware (comparable to processing power of 90's technology) and novelty of the Sugar operating system[12].

### **1.4 Focus of this Thesis**

This thesis explores how this specialized platform can be utilized to encourage children to write creatively. There were two key phases in the methodology of this thesis. First, following the established design principles, two Creative Writing Learning Activities were written (Development). Second, the Learning Activities were evaluated in an educational environment in order to measure their impact on the children's intrinsic motivation to write creatively (Deployment).

## Chapter 2

### PHASE 1: DEVELOPING CREATIVE WRITING SOFTWARE FOR THE XO

During the development phase, existing creative writing software for the platform was first analyzed in order to identify shortcomings. Then, new software was designed and implemented to address these limitations with the goal of increasing interest in creative writing.

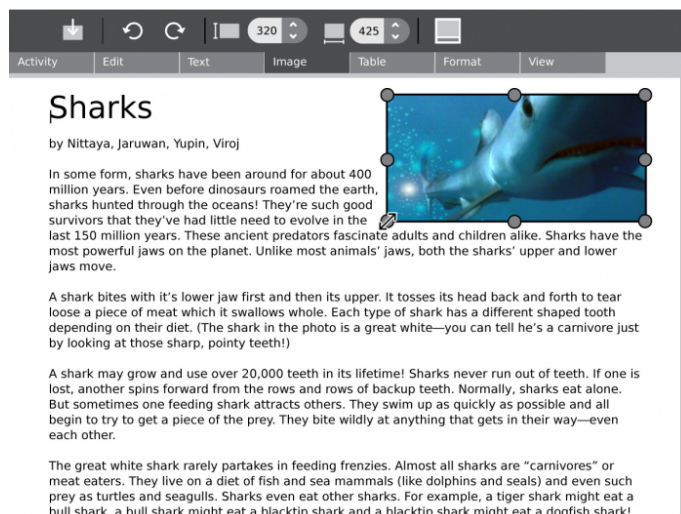
#### 2.1 Existing Creative Writing Software

Although a variety of software exists for the XO, the Learning Activities that are available for the XO are dominated by the fields of Math and Science (fully one-quarter are categorized as such[39]); very few are centered around literacy. The ones that do involve literacy almost invariably focus on reading as opposed to writing. In fact, there are four pre-existing Learning Activities for the XO that are potential candidates for creative writing. The next subsection describes each of these candidates and evaluates them in context of the established design principles.

##### 2.1.1 Write

Given the name, Write appears to be the most obvious candidate for creative writing. However, Write is primarily a Rich Text editor, comparable to WordPad for Windows or TextEdit for Macintosh[50] (See Figure 2.1). Write is a “core” activity, meaning it has been included by default on all distributions of the XO. Although suitable for word processing, it has no special, engaging features for children, beyond changing fonts and inserting pictures. Therefore, although it is fairly Simple and Expressive, it does not have many Enticing features.





**Figure 2.1:** Screenshot of Write

### 2.1.2 E-Toys

E-Toys is a “a media-rich authoring environment with a simple, powerful scripted object model”[38] (See Figure 2.2). E-Toys can be used to create many kinds of media, including animated stories, presentations, web-pages, and videos. Originally developed at Apple in 1996, it is highly Expressive and Interesting, at the cost of a very steep learning curve. Therefore it performs very poorly in terms of being Simple.

### 2.1.3 Scratch

Scratch, developed by the MIT Media Lab in 2003 as a successor to E-Toys, is a programming language and development environment for teaching programming and creation of software (See Figure 2.3). Children write series of instructions using snappable blocks that Actors then carry out. Tightly packaged with graphical and audio resources, Scratch is flexible enough to let beginning programmers create games, programs, and, animated stories[34]. In fact, it has been used with some success as a classroom digital storytelling tool[17][49]. However, this flexibility comes at the cost of complexity; authoring a story requires learning the Scratch environment adequately to

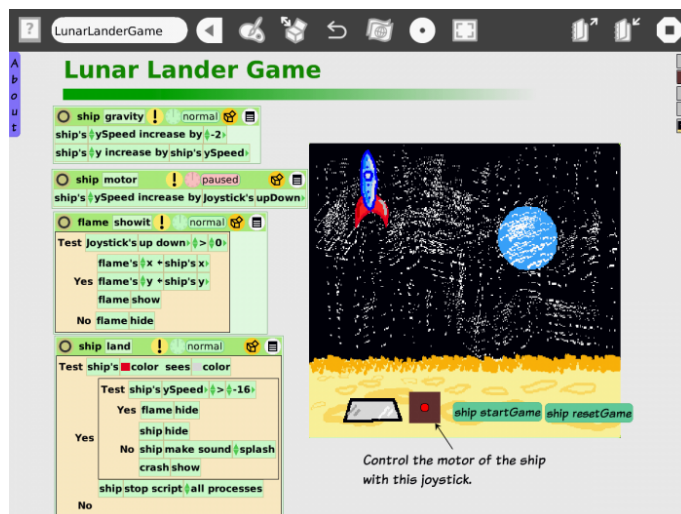


Figure 2.2: Screenshot of E-Toys

utilize it's functionality for storytelling. Further, Scratch is designed more around the idea of animation than writing; for example, writing dialogue is not a seamless task, but instead requires a relatively complicated message-passing system. As creative writing learning software, Scratch does quite well at being Interesting and Expressive, but is not Simple.

#### 2.1.4 Story Builder

Story Builder was written in 2007 as part of the WorldWideWorkshop Project. Explicitly designed for creative writing on the XO, students using Storybuilder can overlay rudimentary animated pictures on a static background, and then write about it in a textbox below (See Figure 2.4). Unfortunately, the most recent release has crippling bugs that make it unsuitable for widespread deployment. Ignoring these bugs, the game is definitely Simple, the graphical elements do make it fairly Interesting, and the freedom with the textbox does make it fairly Expressive.

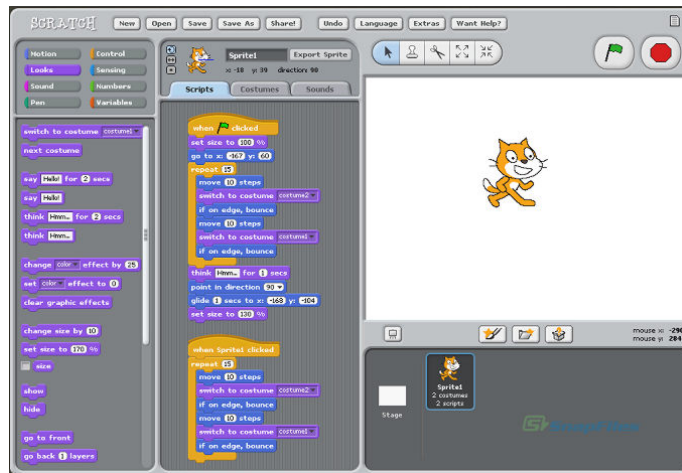


Figure 2.3: Screenshot of Scratch

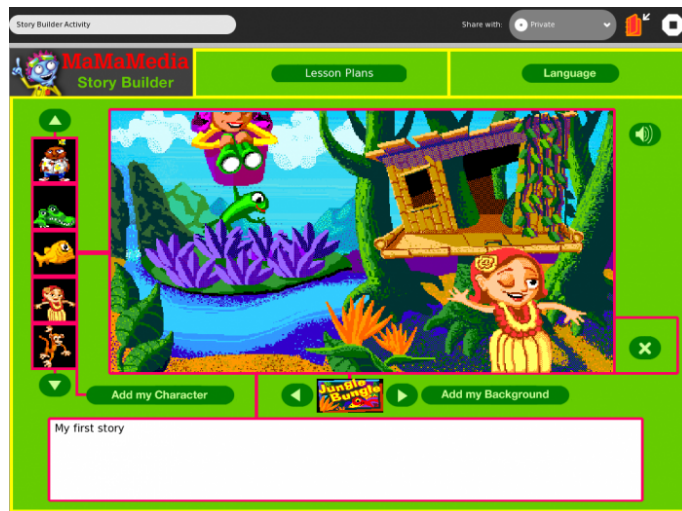


Figure 2.4: Screenshot of Story Builder

**Table 2.1:** Existing Software’s Adherence to Design Principles

<i>Software</i>	Simple	Expressive	Enticing
Write	Fairly well	Fairly well	Not at all
Scratch	Not at all	Fairly well	Quite well
E-Toys	Not at all	Quite well	Quite well
Story Builder	Quite well	Fairly well	Fairly well

### 2.1.5 Summary

The complexity of Scratch and E-Toys stand as a counterpoint to the primitiveness of Write. Story Builder generally does well across the design principles, but there is definite room for improvement, especially since the software has crippling bugs. Table 2.1 summarizes the evaluation of the Learning Activities against the established primary principles.

## 2.2 New Learning Software for Creative Writing

Two Creative Writing Learning Activities were created for this project. The activities were designed to follow all of the primary design principles (Simple, Expressive, and Enticing), and to also follow as many of the secondary design principles as possible. Ideally, both games will be as Simple as Write and Story Builder, but also as Expressive and Interesting as Scratch and E-Toys. Two activities were made instead of one in order to explore different approaches and more accurately identify successes and failures in following individual design principles.

Activity Development on the XO is limited to a few development systems: Browser-based, Flash, and low-level Assembly/C programming, Smalltalk, and Python[10]. Browser-based activities suffer from sandbox-style restrictions inherent in JavaScript, including reduced access to XO Laptop features and poor performance. Flash activities are only possible through the Gnash engine, and the XO distribution’s of this engine suffers from many critical errors, including no support for sound[16]. Most guides advise against programming at the low-level due to the complexity involved, describing

integration with the Sugar Shell as “non-trivial”[10]. Of the two remaining options, Python was chosen as the programming language to develop both learning activities in order to leverage previous programming experiences.

There are two graphical library options available on the XO for Python: Pygame and PyGTK[10]. These two systems represent very different paradigms. Pygame is built for creating animations, at the cost of ease in creating graphical user interfaces. PyGTK is designed for creating graphical user interfaces, but has little support for directly creating animations. These tradeoffs greatly influenced the design of each of the two Learning Activities; one activity was written in Pygame, and the other activity was written in PyGTK.

### 2.2.1 Wacky Writer

The first Learning Activity, named “Wacky Writer”, focuses on the Collaborative design principle; that is, to motivate students to work collaboratively in their creative writing. Although considered a secondary design principle in this work, much research emphasizes the effectiveness of collaboratively-oriented learning software, including the previously identified guidelines established by Gelderblom[13] and work by Cassel, Vaucelle and Ryokai[3][33]. Benford et al. establishes the crucial point that collaboration should add value that is not present in a single-player mode[1].

In “Wacky Writer”, a group of 3-4 students work together to write a single story about a photo, with each student contributing one line at a time. Depending on the game mode, only one or more previously written lines may be visible when it is the student’s turn to write a line. The turn-taking without context of the current story line results in “wacky” stories that children may find funny to read when completed. Figure 2.2.1 shows a story with a Low Wackiness, and Figure 2.2.1 shows a story with a High Wackiness.

The Learning Activity follows a very linear progression, summarized in figure 2.2.1. The rigorous structure of the flow is meant to increase how Simple the game is. Each player in a group starts with their own XO, resulting in one story for each

# Hungry Hippo

By Terra, Edgar, and Sabine



1. **Terra:** There is a hippo named Po. This is his owner.
2. **Edgar:** His owner is trying to get him to eat before he goes on an interview with a Zebra.
3. **Sabine:** If Po is not fed then he will get jelous and start to have a temper tamtrum.
4. **Terra:** This will not be good because he wil be cranky for his interview w
5. **Edgar:** when it is his turn and you do not want a cranky hippo. Espesialy a hungry hippo.
6. **Sabine:** this will give him a bad reputation with the others. so he will have to be good and heathy for the inter view.

Figure 2.5: Wacky Writer Example Story (Low Wackiness)

# Crazy Hippo

By Claire, Tina, Seth, and Zack



1. **Claire:** he is trying to feed a hippo
2. **Tina:** but the hippo took off his arm and went intothe river
3. **Seth:** the hippo then danced the tango in the river andd threw up his arm in the river
4. **Zack:** and ate his other one and then ran out ofthe river when the man re onnected his own arm and
5. **Claire:** reconnectt his leg also
6. **Tina:** the hippo just got up from a nap

Figure 2.6: Wacky Writer Example Story (High Wackiness)

Name	Length of Story
Short	One line per player
Medium	Two lines per player
Long	Three lines per player
Never-ending	Players add lines until the game is manually stopped

**Table 2.2:** Wacky Writer Story Lengths

player. After the title screen (1), the first player for a given laptop enters their fellow players’ names(2) in order (starting with their right and going around in a circle). The first player then browses a built-in library of photos to choose a photo that will serve as the focus of the story (3). Next, the first player adjusts the “Wackiness Level” (described below) and chooses the length of the story(4) (Table 2.2.1 details various story lengths). Once these settings have been configured for each laptop, the players take turns writing a line and then passing the XOs(5). Once the final line has been written, the completed story is displayed and can be read aloud to the rest of the group(6). If the players want, they can begin a new story by returning to the Photo Library (3) and continuing again from there.

Wacky Writer contains 27 different photos that can be used as subjects for the creative writing. Each photo is meant to be unique, interesting, and, most of all, thought-provoking; the photos serve as both a starting point and a reference for the story, in accordance with the Inspirational and Multimedia design principles. Figure 2.2.1 shows several of the photos included in the game. These photos were taken from various open-source collections[28] [41] [19] [24], and are meant to appeal to a diverse range of children, both in terms of culture and gender.

A key feature of Wacky Writer is the “Wackiness” level, which affects the cohesiveness of the resulting story line. At the lowest wackiness level, players can see the entire story while writing. However, as the level increases, fewer and fewer previous lines are shown to the writer. At the penultimate level (the default), only the



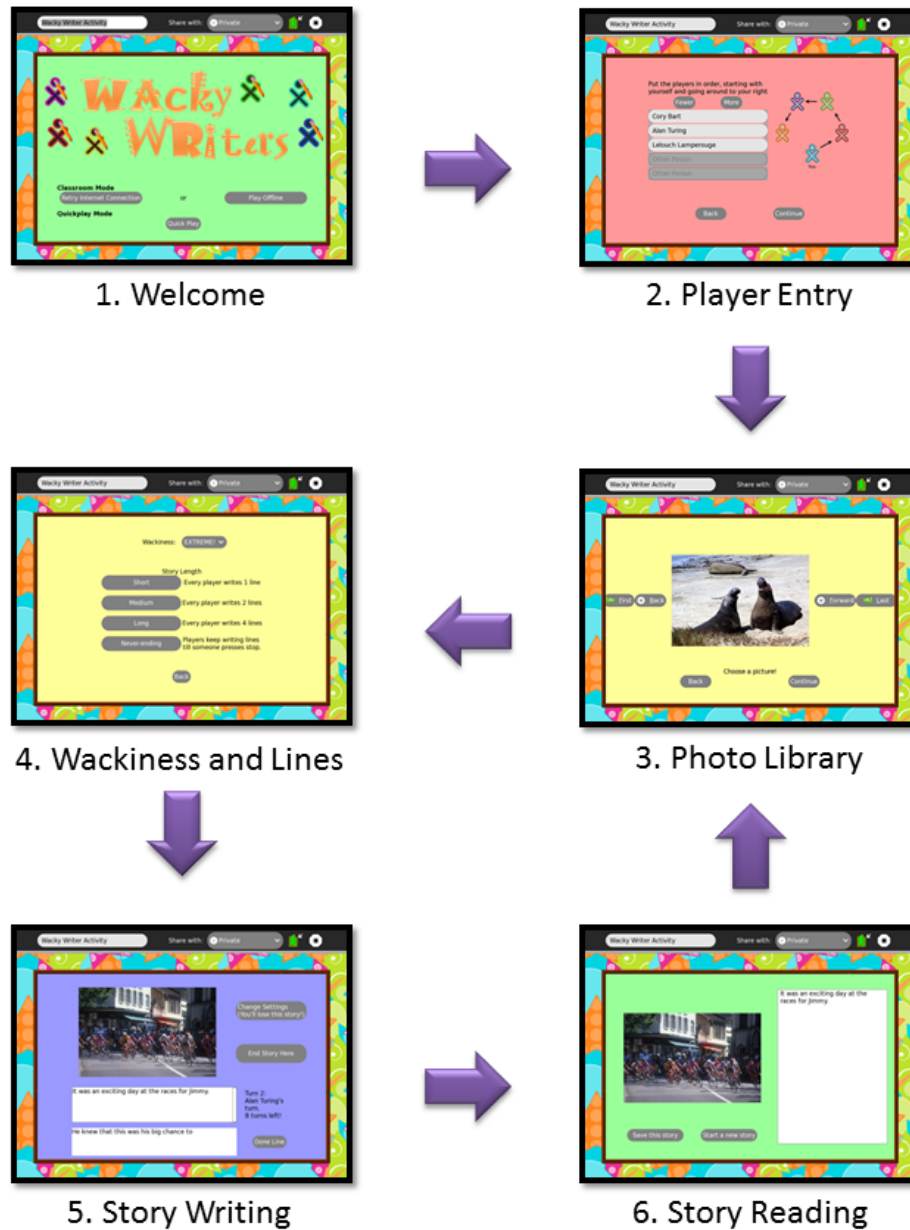


Figure 2.7: Wacky Writer Flow





**Figure 2.8:** Wacky Writer Sample Photos

previously written line is visible. The highest level shows no previous lines, typically resulting in a completely disjointed story, but still concerning the presented photo.

There are historically many problems with networked collaboration on the XO[48], especially in classroom environments. Therefore, a networked version of Wacky Writer was not considered, since students would have been frustrated with the unstable network. Instead, after a line is written, the XO is physically passed to the next player.

#### **2.2.1.1 Implementation**

PyGTK was used to develop this game. Although not optimized for animation, PyGTK works fine for rendering static pictures. PyGTK’s User Interface system is complete and widely used, featuring a wide range of common widgets. In addition, a fully-featured user-interface design program named “Glade” is available, which can be easily connected to the PyGTK libraries to reduce the complexity of creating the User Interface[15]. Glade was used in the creation of Wacky Writer to separate the User Interface design from the internal game logic. In total, Wacky Writer only spans about 1000 lines of Python code and it’s XO Activity Bundle (the archive format for storing portablized Learning Activities for the XO) is about 11MB (largely because of the many photos included).

#### **2.2.2 Broadway**

The second Learning Activity, named “Broadway”, focused on a more individualistic, multimedia-based approach. The expectation is that having multimedia elements will make the Learning Activity significantly more Enticing to children, and also help make the software more Expressive. The goal of Broadway is to create a Play. Plays have a Backdrop, a collection of Actors, and a Script. A Script is a sequence of Dialogue (which is read aloud using text-to-speech technology native to the XO named eSpeak) and Actions (changes in a Actor’s orientation, position, expression, or pose) performed by a Actor on a Backdrop. An example screen shot of Broadway is show in Figure 2.2.2.

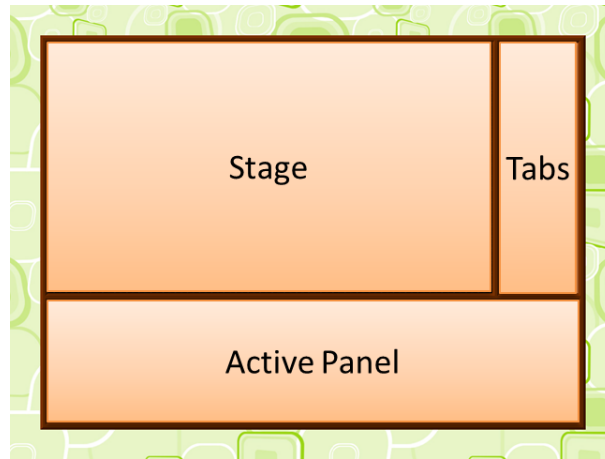


**Figure 2.9:** Broadway Screen Shot

The user interface of Broadway has three general areas, outlined in Figure 2.2.2: the Stage, the Tabs, and the Active Panel. The Stage is the primary feature of Broadway, where all the action of a created script takes place. The Stage is always visible and updates as the script is modified and traversed. This constant feedback is meant to make the software’s current state more obvious to the player and therefore make it more Simple to use. Next to the Stage are the Tabs, buttons that switch between the Panels. There are five Panels, only one of which can be active at a time. This tabbed interface is meant to give a degree of freedom when creating a script.

The five Panels are “File”, “Backdrop”, “Actor”, “Write”, and “Theater” (shown in Figure 2.2.2):

1. **File Panel:** Contains buttons to save, load, and start a new story. This is also where the current story’s title, description, and authors are defined.
2. **Backdrop Panel:** Contains a bank of backdrops that can be browsed. When a backdrop is selected, the stage automatically updates to reflect the new setting.
3. **Actor Panel:** Contains a tabbed interface for editing, adding, and removing the actors of the script. The left side of the panel has controls for invariant properties of an Actor, including their name, actor model (the graphic used for this character, described further below), and voice. The right side holds controls for their initial State (position, orientation, expression, and pose) in the script.



**Figure 2.10:** Broadway User Interface Outline

4. **Write Panel:** Contains a specially-created “Script Box” and a tabbed interface with controls for inserting Actions into the script. The “Script Box” is a Text Box that displays the sequence of dialogue and Actions in the story. Dialogue is displayed as regular text and Actions are displayed in angle brackets. Every time a new Actor gains focus (starts talking or has an action associated with them), a new line in the Script box is started with the actor’s name in square brackets. Dialogue is entered via the keyboard and Actions are entered via the controls on the right. As the script is modified and traversed, the Stage is automatically updated to reflect the current State of the Actors in the Script. At any time, the “Test” button in the upper right of the panel can be used to play the currently selected Dialogue or Action(s), exactly as it would be played in the Theater Panel. When the Narrator is given focus, the controls on the right change to the ones shown in Figure 2.2.2, and Plot Ideas (explained further below) can be inserted into the Script as dialogue for the narrator.
5. **Theater Panel:** Contains controls to adjust playback of the script. The primary controls are, from left to right:
  - (a) Rewind to the beginning.
  - (b) Move a few Actions backwards.
  - (c) Play the story from the current position, restarting from the beginning if at the end of the Script.
  - (d) Move a few Actions forwards.
  - (e) Fast forward to the beginning.

**Table 2.3:** Plot Ideas

Backdrop	Idea
School	The principal’s voice came over the intercom. It was a special announcement!
	Today was the last day of school before summer vacation, and [Actor 1] had a plan to go home early!
Jungle	It was [Actor 1]’s first safari, and he’d already managed to get lost.
	[Actor 1] knew that the school trip had gone very badly, but he didn’t want to scare [Actor 2]. How were they going to get out of this jungle?

Additionally, subtitles can be turned on or off and audio can be muted. The “Theater” aspect is kept distinct from the “Write” panel in accordance with the principle of Modality, which dictates a clear divide between creating/editing a story and viewing it.

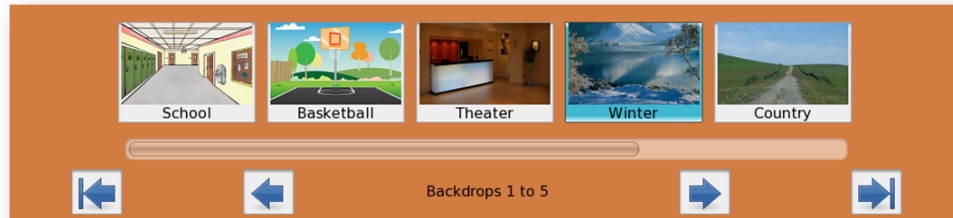
There are several different backdrops available, including a school, an island, a jungle, and several others (Figure 2.13). Each background has an associated set of “Plot Ideas” templates to give students ideas for stories, in accordance with the Inspirational design principle; Gelderblom points out the strength of having a text bank of ideas[13]. Plot Ideas are generated from the templates and reference the actors present in the scene. Table 2.2.2 demonstrates several plots ideas available in the program.

Besides their name and voice, an Actor’s model can also be changed. There are five models available to choose from: “nerd”, “princess”, “hippy”, “cheerleader”, and “child” (Figure ??). Each of these categories has several different palette swaps available, ranging from regular skin tones to bizarre colors. In addition, every script automatically includes an invisible actor named “Narrator”; only the Narrator’s voice can be changed, and they cannot be removed from the script. The Narrator is meant to help add structure to the story.




## 1. File Panel

New	Title: <input type="text" value="Missing Mommy"/>	Broadway by Austin Cory Bart Graphics by Margaret Spagnolo PGU by Phill Hassey and Peter Rogers Spiral by Robert Deaton Pygame from various Espeak from various Icons from various Based on Hollywood, by Theatrix.
Load	Author(s): <input type="text" value="Meg"/>	
Save	Description: <input type="text" value="Little girl loses her mom at the beach and does not know where to look"/>	
Save As		




## 2. Backdrop Panel



## 3. Actor Panel

 Narrator	 Name	 Name	Add actor	Remove Actor
Name: <input type="text" value="Maria"/>		Initial Look: <input type="text" value="Cocky"/>		
Actor: <input type="text" value="Cheerleader (Brown)"/>		Initial Pose: <input type="text" value="Stands"/>		
Voice: <input type="text" value="Female 1"/> Test		Initial Face: <input type="text" value="Left Right"/>		
		Move or start offscreen <input type="checkbox"/>		

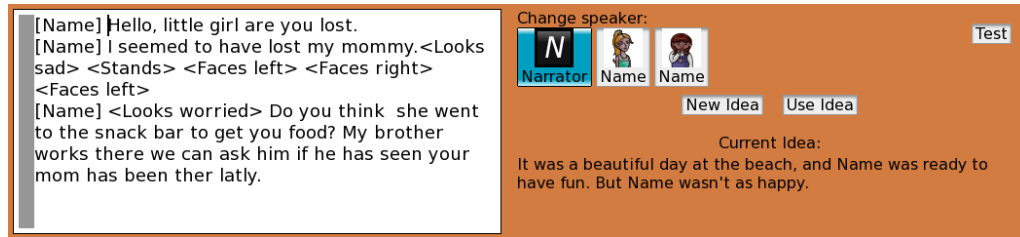
## 4. Write Panel

<div>[Maria] Hello, little girl are you lost. [Anna] I seemed to have lost my mommy. &lt;Looks sad&gt; &lt;Stands&gt; &lt;Faces left&gt; &lt;Faces right&gt; &lt;Faces left&gt;   [Maria] &lt;Looks worried&gt; Do you think she went to the snack bar to get you food? My brother works there we can ask him if he has seen your mom has been ther latly.</div>	<div>Change speaker:  Narrator  Maria  Anna</div> <div>Look: <input type="text" value="Cocky"/></div> <div>Change Pose: <input type="text" value="Stands"/></div> <div>Face: <input type="text" value="Left Right"/></div> <div>Leave: <input type="text" value="Left Right"/></div> <div>Move <input type="checkbox"/></div> <div>Test</div>
--	---

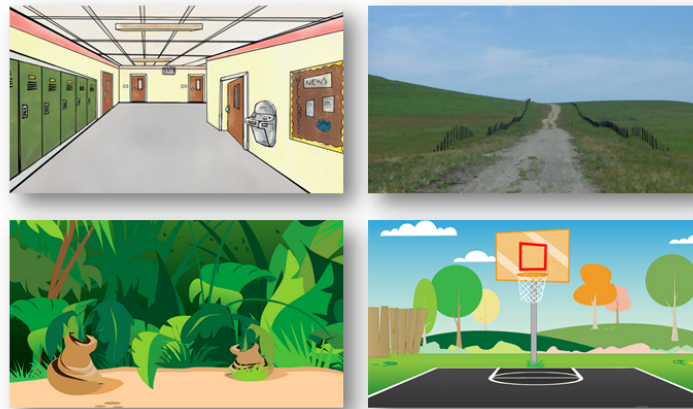
## 5. Theater Panel



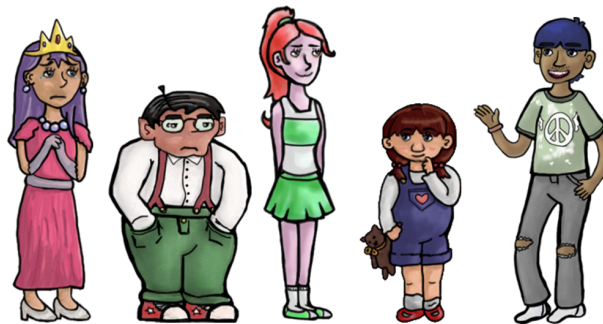
Figure 2.11: Broadway User Interface - Panels



**Figure 2.12:** Broadway User Interface - Narrator's Write Panel



**Figure 2.13:** Example Broadway Backdrops: School, Beach, Country, Basketball Court. Some Backdrops were taken from online galleries[43][45][46]



**Figure 2.14:** Broadway Actors

### 2.2.2.1 Implementation

Because of the animation-heavy aspects, this Learning Activity was written in Pygame[10] — additionally using the Spyral library to simplify the animation involved. Unfortunately, Pygame does not have any native User Interface modules, requiring a third party solution. Given the many constraints of the system, the most light-weight option was chosen — PGU (“Phil’s Game Utilities”). Although largely complete, this package had some holes and required a large amount of customization to use to build Broadway’s user interface (for example, PGU does not have built-in support for tabbed interfaces, requiring custom-written solutions). Additionally, there is no convenient external program for user interface development like “Glade”, requiring a significant amount of the design to be embedded directly in the program. In total, Broadway spans about 4500 lines of Python, not including 3rd party libraries — though some of those libraries underwent extensive revision during the project. It’s Activity Bundle is a little under 6MB.



## Chapter 3

### PHASE 2: STUDY OF CHILDREN’S USE OF CREATIVE WRITING SOFTWARE

#### 3.1 Goals of the Study

The primary goal of the study was to gauge motivation and interest of students as they used the two Learning Activities. The secondary goal is to determine whether the primary design principles were met, from a child’s perspective. Finally, the tertiary goal is to get suggestions on improvements to both Learning Activities.

#### 3.2 Educational Environment and Human Subjects

The evaluation protocol for this project called for the creative writing learning activities to be used in an educational environment by children, who were surveyed and interviewed afterwards. The educational environment selected for this project was The College School at the University of Delaware, a laboratory school on campus. The school has 70 students ranging in age from 6 to 14 years old[42], although for this study we only met with a total of 29 students. Classes are divided into Ability Groups of about 8 students, based primarily on student ability level, as measured using DIBELS (Dynamic Indicator of Basic Early Literacy Skills) screening assessment and a battery of other testing[11]. Within the grades 4-8, this means that the students were placed into 4 groups, all at roughly the same literacy levels inside the same Ability Group. Table 3.2 summarizes their demographic information.

The College School places a great deal of emphasis on working individually with students. There is a 1:1 student-computer ratio in the school, so students already have a significant background with technology. However, the students have MacBooks, so they have never worked with XOs before. The students typically come from stable

**Table 3.1:** The College School Student Demographics

	Female	Male	Total
Level 1	2	5	7
Level 2	2	3	5
Level 3	7	1	8
Level 4	5	4	9
Total	16	13	29

**Table 3.2:** Classroom Intervention Schedule

	Day 1	Day 2	Day 3	Day 4
First Session (10:10 – 11:00)	Group 1	Group 1	Group 3	Group 3
Second Session (11:00 – 10:40)	Group 2	Group 2	Group 4	Group 4

socio-economic areas. However, many of the students have school-affective disabilities, include learning, reading, attention, mild social/emotional, and/or mild behavioral issues. These disorders could be a threat to the validity of the results repeated here. However, they do not have the capability to work with students with more severe disabilities, such as developmental delays, autism spectrum disorders, or severe communication disorders, so it should not have a drastic impact.

### 3.2.1 Protocol

The primary investigator intervened with each of the four Ability Groups over the course of four days, as described in Table 3.2.1. The primary investigator met with each group twice. Figure 3.1 summarizes the protocol. During the sessions, the primary investigator interacted directly with students, while an assistant took notes from a detached, third-person point-of-view. No rewards or consequences were given for involvement in the study. All activity was fully voluntary, and both student assent and parental consent were obtained prior to the intervention.



**Figure 3.1:** In-classroom Protocol Overview

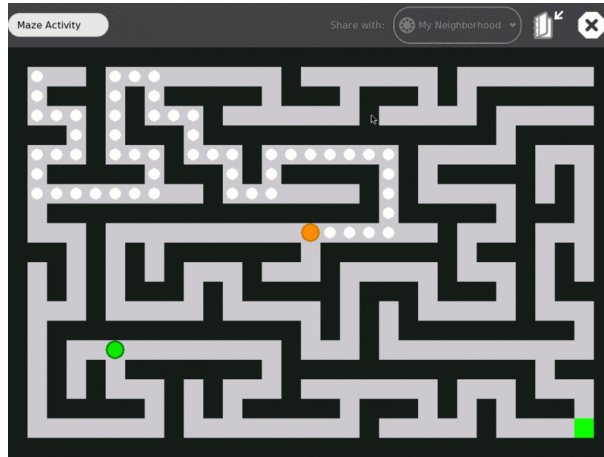
#### 3.2.1.1 “Introduction to XO” Presentation

To ameliorate the aforementioned effects of unfamiliar hardware, a 3-minute Introductory Presentation was given to acclimate the students to the XO platform. Key features and characteristics of the XO were explained, along with some background information on the OLPC project and its goals.

#### 3.2.1.2 Free Time

After the introductory presentation, XO laptops were distributed. Students had “Free Time” to try out the XO and get comfortable with the Sugar interface. Students played at least one of three learning activities native to the XO: Maze, Physics, or Speak.

**Maze Activity** Described as a “simple maze game for the XO laptop”, the goal of Maze is to guide a circle from one side of the maze to the other. Every time a maze is completed, a larger maze is procedurally generated and play restarts. Initial mazes can be completed very quickly, but successively larger mazes can take several minutes.<sup>[22]</sup> An example of the game in use is shown in Figure 3.2.



**Figure 3.2:** Maze Activity Screen Shot

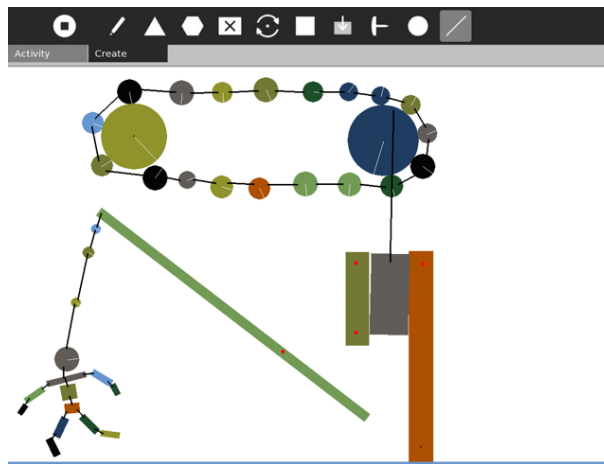
**Physics Activity** “A physical world simulator and playground — you can add squares, circles, triangles, or draw your own shapes, and see them come to life with forces... friction ... and inertia ...” [29]. An example of the game in use is show in Figure 3.3.

**Speak Activity** “Speak is a talking face for the XO laptop. Anything you type will be spoken aloud using the XO’s speech synthesizer, espeak. You can adjust the accent, rate and pitch of the voice as well as the shape of the eyes and mouth. This is a great way to experiment with the speech synthesizer, learn to type or just have fun making a funny face for your XO.” [35]. An example of the game in use is show in Figure 3.4.

These activities were chosen because they are simple and fun activities that don’t require a lot of set-up or take much time to accomplish anything. In total, students were given 5-10 minutes to try these learning Activities and explore the XO.

### 3.2.1.3 Learning Activity # 2 (Broadway)

Students were given a quick 2-minute walkthrough of the Broadway environment, explaining the purpose of each of the five panels. They were then instructed to spend the next 10-15 minutes writing a story of their choice, using the Plot Ideas feature if they needed guidance. After the story was completed, they were instructed



**Figure 3.3:** Physics Activity Screen Shot



**Figure 3.4:** Speak Activity Screen Shot

to save it to the XO, and they could then watch their play acted out in the Theater mode. In total, 15-20 minutes were spent using this game.

#### **3.2.1.4 Learning Activity # 1 (Wacky Writer)**

This activity began at the start of the second session, so when students entered the classroom they were immediately divided into groups of 3-4. Students were guided through the settings menu. Although they had leeway in choosing a picture, they were directed to first choose the “Medium” story length option with a “low” wackiness rating (all previously written lines shown). Once they began writing, they were given approximately one minute to write each line, with the Primary Investigator calling out when to advance by using a stop-watch. After the story was completed, students were allowed to read it over and share their story with the class. Then they were given a chance to write another “medium”-length story with a “high” wackiness level (only one previously written line shown), once again having 1 minute to write per line. This activity took 15-20 minutes.

#### **3.2.1.5 Post-Activity Survey**

Directly after each activity, an 18-question survey was distributed. Students were directed to answer the survey to the best of their ability, after which they were collected and the students were given free time (with the XO, if they so desired).

#### **3.2.1.6 Focus Group**

Finally, a small subset of students (3-4 per Ability Group) were chosen for a discussion group. They were asked open-ended questions about the XO and the Learning Activities. The objectives were to gather qualitative data about the effect of the Learning Activities on their intrinsic motivation, the success of the Design principles, and the student’s ideas about how the games could be improved.

**Table 3.3:** Intrinsic Motivation Inventory Subscale Presence

Intrinsic Motivation Inventory Subscale Presence			
Category	Positive Questions	Negative Questions	Total Questions
Interest/Enjoyment	3	2	4
Perceived Competence	2	1	3
Pressure/Tension	1	1	2
Perceived Choice	1	1	2
Value/Usefulness	4	0	4
Effort/Importance	1	2	3
Total	12	6	18

### 3.2.2 Survey Instrument

The Post-Activity questionnaire used to survey the students was based on the Intrinsic Motivation Inventory (IMI), a multidimensional measurement device for assessing subjective experience related to a target activity[31]. The instrument contains a set of statements related to areas of Intrinsic Motivation and students indicate how much each statement ranges from “Not true” to “Very true” for them. The instrument is often reworded and reduced for a specific experiment, as it was in this case. The Intrinsic Motivation Inventory uses balanced keying to avoid acquiescence bias, including both positive and negative statements. Studies have shown strong support for its validity[31].

The original instrument is composed of seven categories, of which six were chosen (the seventh category, relatedness, was left out). As some aspects were of more interest than others, they were given more presence in the modified instrument, as summarized in Table 3.2.2. The decisions to include or exclude a subscale, and to what degree, are summarized below along with brief descriptions of the subscales.

**Interest/Enjoyment** Considered the self-report measure of intrinsic motivation and thus the most important element of the scale. This correlates to the Enticing design principle, and to some degree the Expressive principle. A large percentage of the items on the questionnaire were related to this subscale, as is typical for an instance of the Intrinsic Motivation Inventory[9].

**Perceived Competence** Along with Perceived Choice, theorized to be “positive predictors of both self-report and behavioral measures of intrinsic motivation” [9]. Perceived competence was considered important due to it’s direct relation to the Simple design principle.

**Perceived Choice** A positive predictor of self-report like Perceived Competence, Perceived Choice is related closely to the Enticing design principle, although, since Interest/Enjoyment is also similar, Perceived Choice was given a more subdued presence in the questionnaire.

**Tension** In opposition to the Perceived Competence and Choice subscales, Tension acts as a negative predicator of self-report[9]. Given the educational environment and lack of negative consequences, it was decided that this element was relatively unimportant, and it does not have a significant presence in the questionnaire.

**Effort** A separate variable from the above subscales, Effort measures how much work the child put into the activity. This was related to both Simplicity and Enticiness, and so had a somewhat strong presence.

**Value/Usefulness** Used to measure internalization, this subscale had a relation to the Enticing design principle. Interestingly enough, there are no negative statements associated with this key in the original Intrinsic Motivation Inventory, and to be consistent with other studies the Primary Investigator decided not to incorporate any.

**Relatedness** This item was not included because it is commonly used in studies involving interpersonal interactions. Although the Wacky Writer activity does involve interaction, Broadway does not, and there was a strong desire for consistency across the surveys.

Originally, the tool was on a 7-point likert scale, but this was downscaled to 5 points, with the expectation that children would find too many values to be confusing. Additionally, of the original 24 questions, only 18 were chosen to be included based on the determined importance of each category. Finally, the ordering of the questions was randomized and then manually refined.



## Chapter 4

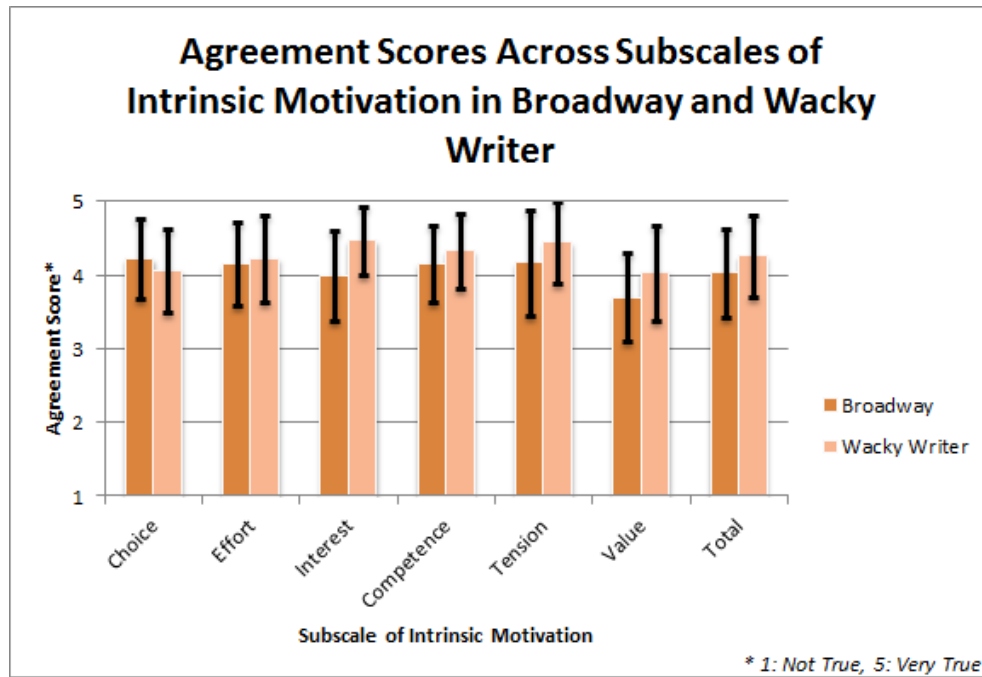
### RESULTS

#### 4.1 Quantitative Results

In total, 29 Post-Activity surveys were collected for each game, resulting in a total of 58 surveys. Of these 58 surveys, only one question was unanswered by one student, relating to Perceived Choice in using Wacky Writer. When the data was being evaluated, this question was not included in calculations.

Responses for a question on the Post Activity Survey are on a scale of 1 to 5, where 1 is “Not True”, 3 is “Somewhat True”, and 5 is “Very True”. The responses to the statements in each subscale were averaged together to find an Agreement Score for that subscale. When combining data for a subscale, negative statements were inverted using the formula  $score_{adjusted} = 6 - score_{raw}$  and positive statements were left as is. As Tension is a negative indicator, questions relating to Tension that were negative were not adjusted and positive statements were inverted. Once all the adjusted scores were created, all agreement scores were averaged without weight to find the Total Agreement Score. Figure 4.1 graphs these results of the Post-Activity Survey for both Broadway and Wacky Writer. The black error bars indicate the range of 1 standard deviation for that subscale’s agreement score.

Table 4.1 details the computed Cronbach’s Alpha for the subscales of the two surveys, and for the surveys overall. Cronbach’s Alpha is a coefficient of reliability. It is commonly used as a measure of the internal consistency or reliability of a psychometric test score such as the Post-Activity Surveys. George and Mallery (2003)[14] identify an Alpha of  $> .7$  as being “Acceptable”, and an Alpha of  $< .5$  as being “Unacceptable”. Based on these measures, a filtered version of the original Agreement Score across Subscales graph was created, shown in Figure 4.2.

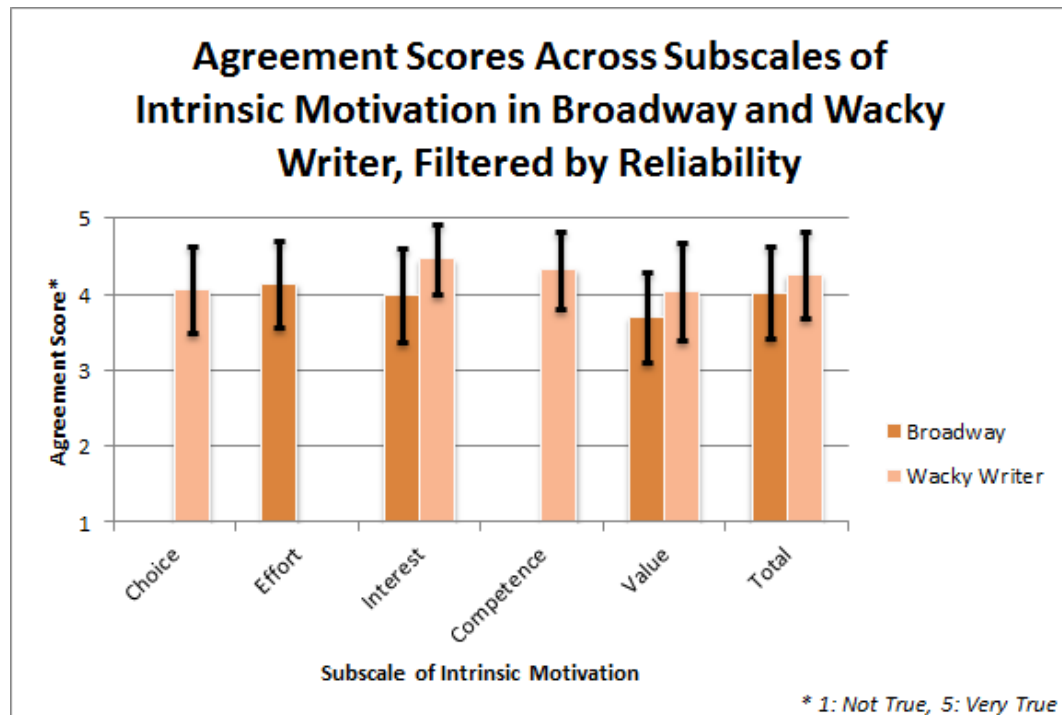


**Figure 4.1:** Agreement Scores Across Subscales of Intrinsic Motivation in Broadway and Wacky Writer

**Table 4.1:** Cronbach's Alpha of the Post-Activity Surveys

Category	Wacky Writer	Broadway
Interest/Enjoyment	.74*	.88*
Perceived Competence	.74*	.68
Pressure/Tension	.39	.26
Perceived Choice	.80*	.53
Value/Usefulness	.87*	.87*
Effort/Importance	.37	.70*
Entire Survey	.84*	.87*

\* above commonly accepted threshold

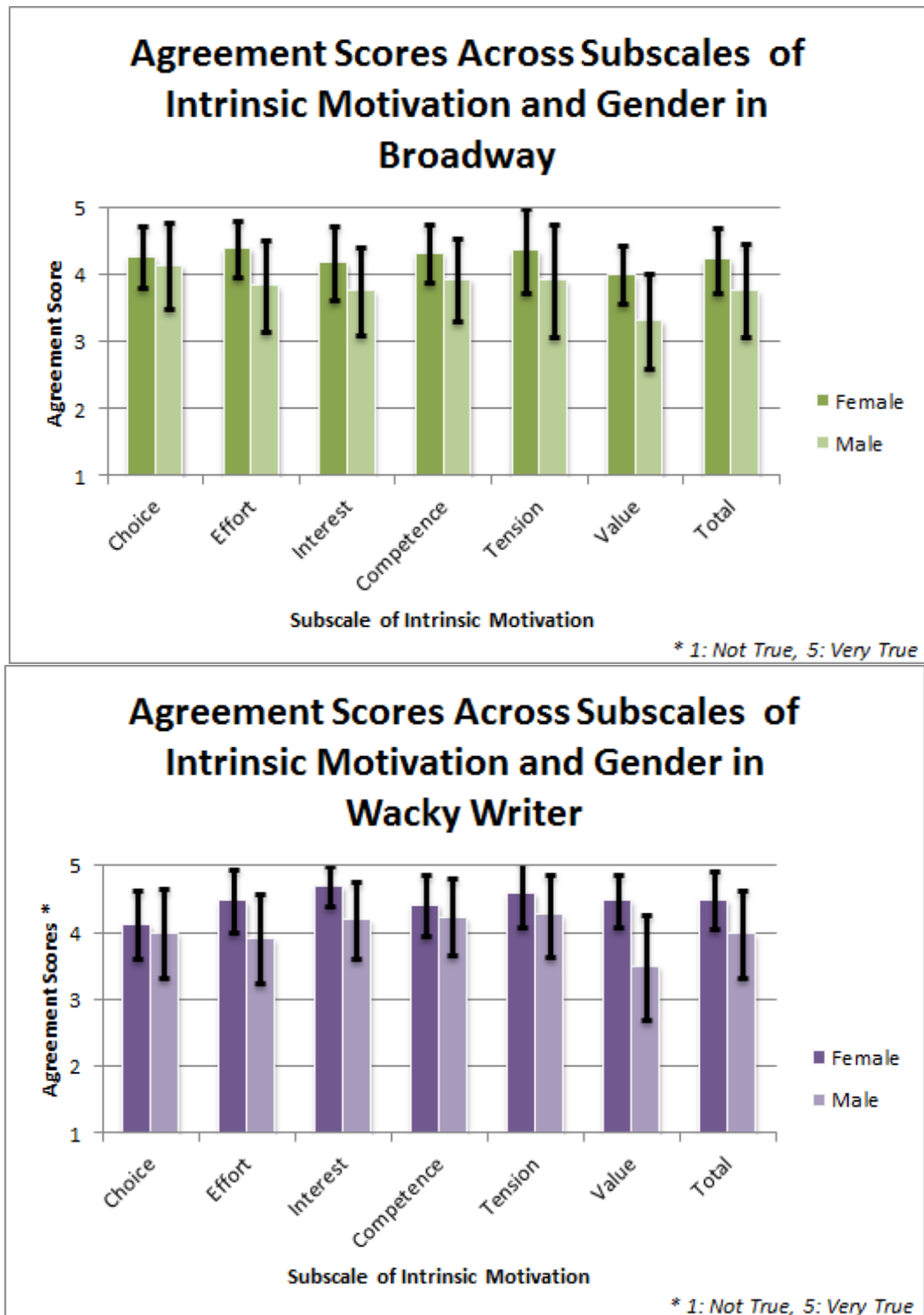


**Figure 4.2:** Agreement Scores Across Subscales of Intrinsic Motivation in Broadway and Wacky Writer, Filtered by Reliability

By combining the results of the Post Activity Survey with collected demographic information, additional relationships can be identified. Figure 4.3 demonstrate the relationship between gender and subscales of intrinsic motivation in the two Learning Activities. Although data was collected on Ability Levels of students, the number of students in each section was so small and the gender distribution was so uneven, the resulting relationships were considered too tenuous to analyze.

## **4.2 Qualitative Results**

Qualitative data was collected at two points during the intervention. First, while the children were using the two Learning Activities, an assistant to the Primary Investigator took notes on how the students reacted to the Activities. Second, after the children had finished using the two Learning Activities, a subset of students were asked open-ended questions in a discussion group setting, while their answers were recorded digitally.



**Figure 4.3:** Agreement Scores Across Subscales of Intrinsic Motivation and Gender in Creative Writing Learning Activities

## Chapter 5

### DISCUSSION AND CONCLUSIONS

#### 5.1 Motivation and Interest of Children Using the Learning Activities

The primary purpose of the data collected through the Post-Activity Survey was to gauge motivation and interest of students as they used the two Learning Activities. As previously described, there were 6 subscales measuring Intrinsic Motivation that were included in the survey. Overall, it seems that children were highly motivated to use the games. Although several of the Subscales' Agreement Scores were not statistically reliable according to Cronbach's Alpha, the results do seem consistent across the different subscales. The standard deviation of every Agreement Score ranges from 3 ("Somewhat True") to 5 ("Very True"), suggesting that students felt intrinsically motivated to play the Learning Activities.

The primary metric of Intrinsic Motivation, Interest/Enjoyment, was particularly high in Wacky Writer; as the self-report measure of intrinsic motivation, this indicates that students particularly enjoyed Wacky Writer. Students also reported perceiving themselves as being very Competent at Wacky Writer, most likely because of how linear and structured it is. Looking at the breakdown between genders, girls seemed to enjoy the game more than boys; the average of every single Agreement Score was above 4, and with the exception of Percieved Choice, the standard deviation of each Agreement Score was between 4 and 5. Boys' scores all still averaged above "Somewhat True" threshold, indicating that they were at least somewhat motivated. The most interesting statistic to point out is the low average but high variance of the Value subscale, indicating that boys were split on the internalized utility of the game.

The Agreement Scores for Broadway were typically around half a point lower than the corresponding Scores for Wacky Writer. However, all the scores were still very

positive, with all the reliable average Scores close to 4. Once again, girls tended to enjoy the game more than boys. Agreement scores for girls in Broadway are roughly the same as the ones for Wacky Writer, with the exception of the Value and Interest subscales, which averaged a half-point lower for Broadway.

From the results gathered, it seems that although both Learning Activities were enjoyed, Wacky Writer was more interesting and had more value to children. Although the difference is not large, Wacky Writer's Total Agreement Score was higher than Broadway's. In every other reliable category, Wacky Writer had a higher score, too. When including unreliable scores, Perceived Choice was the only category where Broadway outperformed Wacky Writer, a metric that was not considered of high importance in the study anyway.

During the open-ended discussion, children cited the collaborative features of Wacky Writer as being the key to its success.

**Child:** *I like this one [Wacky Writer] better than the other one [Broadway].*

**Investigator:** *Why do you think you liked this game more than the other one?*

**Child:** *Um because there was more group interaction. Like, I like working with other people, so this was kinda fun.*

Students seemed to think that working in a group also made the writing process easier:

**Child 1:** *I liked this one better, because you could write about someones picture. It was a lot easier.*

**Child 2:** *It helped you come up with ideas easier. You could build off what people before you said.*

**Child 3:** *You get to see what other people get to say about that picture.*

They also mentioned that the collaboration led to variety in the stories.

**Child:** *I liked how everybody had a different perspective for each story. For an example, with the horses, they changed it up. You could change it up a bit like with what you want and people follow.*

Students also seemed to react more positively to the photos of Wacky Writer than to the Backdrop and Actors of Broadway. They seemed to like how the photos had specific details, compared to the generic-ness of the Broadway Backdrops and Actors:

**Investigator:** *How could it [Broadway] be better? To make it more like this game [Wacky Writer]?*

**Child:** *Different, more types of people. And backgrounds. More backgrounds, more variety of backgrounds. Persons that go with their backgrounds.*

Students had a very positive reaction to the XOs, with some asking how they could purchase their own. They were particularly attracted to its portable size, rugged exterior, and the dual-mode display that can be used outside. One thing they did not like was the keyboard, which they said was too small and “felt weird”, though this may simply be a matter of needing to get used to a different form factor. Some students mentioned that they wanted the games to use networking instead of having to pass the laptops around.

**Child:** *What I think would be cooler or funner is um, if instead of having to pass the computers around, you could just like set up like three people and it like wirelessly sends it to other people.*

## 5.2 Success of the Design Principles from the Children’s Perspective

In the first chapter of this thesis, 3 primary design principles were established to evaluate the existing software: Learning Software should be Simple, Expressive, and Enticing. Overall, the students seemed to find the games met all three principles to some degree. Many students repeatedly mentioning that they liked the games and that they were fun, expressing a lot of Interest in it. In fact, they mentioned that they enjoyed the game more than usual writing process in class.

**Teacher:** *Which did you prefer more, the game you did yesterday [Broadway] or what we do regularly in class [writing by hand], which do you enjoy more?*

**Child:** *... The game we played yesterday...*

**Teacher:** *You’re not going to hurt my feelings, because I think you enjoyed the game yesterday more.*

**Children:** *Yeah. Yeah!*

**Child:** *I liked the game yesterday instead of writing.*

In terms of being Simple, no one had any trouble understanding the basics of the programs, although while playing Wacky Writer one group repeatedly lost track



of who's turn it was, resulting in confusingly jumbled stories. It is unclear from the Intervention if the student's success in using the software was due to it being intuitive or due to the tutorial given at the start of using the program.

Most of the students didn't seem to think that using the programs had a significant effect on their ability to express themselves:

**Investigator:** *Did you feel more creative?*

**Child:** *Not really.*

Still, all of the students reported enjoying the games and seemed eager to share their stories with each other and the investigator. They didn't report any feelings of being constrained by the environment; indeed, students seemed to be more concerned with getting new ideas (from photos and previously written lines in Wacky Writer or Backdrops and Actors in Broadway) than being unable to express ones that they have. It is possible that this was because of the small time frame of the Intervention.

### 5.3 Conclusions

Ultimately, the children enjoyed the two Learning Activities. Wacky Writer was more popular among the students, most likely because of its collaborative features and interesting photos. Girls tended to like the activities more than boys, especially Wacky Writer. Regardless of the success though, there are improvements that can be made to both Activities, especially with relation to the primary and secondary design principles established, and to the intervention protocol.

## Chapter 6

### RECOMMENDATIONS

#### 6.1 Recommendations for Future Interventions

There are many ways that the intervention could be repeated with more useful results. First, like any education-oriented research project, it would be beneficial if the study were repeated in different educational environments, with larger class sizes, and with students of more varying backgrounds. Best of all would be if the intervention could occur in the most common environment for the XO: classrooms in 3rd world countries in Latin America and Africa. Also excellent would be if the length of the study could be increased, giving more time for students to become familiar with the Learning Activities. The study could also be extended to measure student's intrinsic motivation to use the pre-existing creative writing learning activities: Scratch, E-Toys, Story Builder, and Write. Finally, it would be useful to establish if there is an increase in intrinsic motivation to write by hand versus using Broadway and/or Wacky Writer; in order to do so, a pre-test similar to the post-activity survey would need to be distributed to the students to gauge their intrinsic motivation to write creatively.

#### 6.2 Improvements to the Creative Writing Learning Activities

The focus of these learning activities was to create Learning Software that would increase intrinsic motivation to write. However, recent work by Chong et al [4] points out that it is also desirable to encourage deeper learning when it comes to creative writing. Chong has created a “framework synergizing pedagogical elements with technical scaffolding for a creative writing learning software” [4] that would be of great use in designing future versions of Broadway and Wacky Writer. In addition, they created a modular system based on their framework using Adaptive Learning — a method that

adapts the presentation of material according to students’ weaknesses[26] — which could be easily integrated into the backend of these Learning Activities in order to help students improve their writing ability instead of just their motivation to write. This would help fulfill two secondary design principles that were not properly achieved in either game: Organizational and Supportive.

In fact, even basic spelling and grammar checking tools would be extremely useful to include in these Learning Activities. The decision was made early-on to not include spelling and grammar checking tools into Broadway because of the technical complexity involved, but Wacky Writer was originally intended to have both these features. However, most of the development time was spent on Broadway and there wasn’t sufficient time to add this feature into Wacky Writer, even though there are existing solutions for PyGTK. This should become a priority for Wacky Writer.

One of the more common ways that the secondary design principle of Collaboration is expressed is through sharing of created media. This practice is used with great success in the Scratch community, and having a similar feature for these Learning Games would be quite excellent. In fact, having simple methods to export the created stories in commonly used formats would be quite advantageous for either game.

### **6.2.1 Specific Recommendations for Wacky Writer**

Wacky Writer has several places where gameplay can be greatly improved. After being used in a classroom setting, it didn’t seem worthwhile to keep careful track of which player should take their turn. If one child accidentally clicks the “Done Line” button twice, then the next player misses their turn; since it is not always obvious that this has happened, and there are no physical barriers from that player proceeding, the authors will be off by one from there out. Therefore, instead of the Players scene requiring that users input their names in order, they should simply be allowed to list the authors when they input the title. By not enforcing an order, the game is more robust against skipping turns. Another common problem was one student in a group being unready to pass their XO when time was called. This causes a “blocking” effect

that can frustrate the other children and increase the tension of the blocking child. One potential solution is to allow students to trade laptops whenever two of them have finished. Unfortunately, this raises further potential problems: coordinating laptop exchanges becomes significantly more difficult and faster writers may start dominating the stories. Although Wacky Writer allows you to review a story after it has been written, there is no way to review and edit it directly from the program. So although it follows the Modality principle in practice, it does not follow it in spirit.

### **6.2.2 Specific Recommendations for Broadway**

After the Development phase was completed, it was discovered that PyGTK could integrate animated canvases directly into its main Window. With sufficient optimization, Broadway might be rewritten as a PyGTK-based application the same as Wacky Writer. At the minimum, this could enable several useful features, such as Tabbed Interfaces and spelling and grammar checking.

Although the children seemed pleased with the diversity of the photos in Wacky Writer, they were not satisfied with the amount of Actors and Backdrops in Broadway. One of their suggestions for Backdrops was to make them more heavily detailed, similar to the highly detailed photos in Wacky Writer. They also suggested adding Actors that would be thematically appropriate to certain Backdrops. Other requests included non-humanoid Actors such as dogs or monkeys, props that could be held in actors hands, and large pieces of scenery such as a car or boat. Originally, there were plans to have foregrounds in front of the Actors and specific animations for the Actors, such as laughing or crying. These animations require vocalizations that the eSpeak software is not competent at emulating, so they would need to be included as sound effects, which opens the door for special sound effects and musical stings (short pieces of music played to set a scene). Of course, Broadway is limited in how much of the screen can be animated, but attempts should be made to gauge just how far the system can be pushed.

The current Text-To-Speech technology, eSpeak, is not very sophisticated. The voices it generates have a tinny, robotic edge to them. Although none of the students seemed to have a significant problem with this (possibly because of the Juxtapositional principle), there is room for improvement. There is work being done by the OLPC developers to find a new speech framework[\[37\]](#); if one is found, it could be bundled directly with Broadway.

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Appendix  
**APPENDIX**

### **Student Post-Activity Survey**

Student Name: \_\_\_\_\_

Group Number (Circle one):      1              2              3              4

Learning Activity (Circle one):      Wacky Writer              Broadway

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*Read each statement carefully and indicate how true it is for you:*

**1) I enjoyed playing this game very much**

1                      2                      3                      4                      5  
Not true                      Somewhat true                      Very true

**2) I tried very hard at this game.**

1                      2                      3                      4                      5  
Not true                      Somewhat true                      Very true

**3) This game did not hold my attention at all.**

1                      2                      3                      4                      5  
Not true                      Somewhat true                      Very true

**4) I would be willing to play this again because it has some value to me.**

1                      2                      3                      4                      5  
Not true                      Somewhat true                      Very true

**5) I felt very tense while playing this game.**

1                      2                      3                      4                      5  
Not true                      Somewhat true                      Very true

**6) I played this game because I had no choice.**

1                      2                      3                      4                      5  
Not true                      Somewhat true                      Very true

**7) I think I am pretty good at this game.**

1                      2                      3                      4                      5  
Not true                      Somewhat true                      Very true

**8) I didn't put much energy into this.**

1                      2                      3                      4                      5  
Not true                      Somewhat true                      Very true

**Figure A.1:** Student Post-Activity Survey (Side 1)

<b>9) This was a game that I couldn't play very well.</b>				
1	2	3	4	5
Not true		Somewhat true		Very true
<b>10) I did not feel nervous at all while doing this.</b>				
1	2	3	4	5
Not true		Somewhat true		Very true
<b>11) I think playing this game could help me to be more creative in my writing.</b>				
1	2	3	4	5
Not true		Somewhat true		Very true
<b>12) I played this game because I wanted to.</b>				
1	2	3	4	5
Not true		Somewhat true		Very true
<b>13) This game was fun to play.</b>				
1	2	3	4	5
Not true		Somewhat true		Very true
<b>14) I thought this was a boring game.</b>				
1	2	3	4	5
Not true		Somewhat true		Very true
<b>15) I think that playing this game is useful for writing creatively.</b>				
1	2	3	4	5
Not true		Somewhat true		Very true
<b>16) I believe playing this game could be beneficial to me.</b>				
1	2	3	4	5
Not true		Somewhat true		Very true
<b>17) While I was playing this game, I was thinking about how much I enjoyed it.</b>				
1	2	3	4	5
Not true		Somewhat true		Very true
<b>18) After working at this game for a while, I felt pretty competent.</b>				
1	2	3	4	5
Not true		Somewhat true		Very true

**Figure A.2:** Student Post-Activity Survey (Side 2)