FRAMEWORK FOR DEVELOPMENT OF SCHEMATA IN CHARACTER DESIGN FOR COMPUTER ANIMATION

A Thesis

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ABSTRACT

The activity of designing characters for computer animation demands a great deal of complex problem-solving and decision-making techniques. It requires combining aspects from the story, subjective ideas and abstract visual elements, such as lines, shapes, colors, in order to generate a character that can be understood and believable. There is a lack of comprehensive documentation and shared knowledge about the process in literature. This presents a setback for new designers seeking in-depth information on character design, since having a thorough understanding of this process is the first step in developing expertise in the field of character design. This practice-led research establishes a cohesive framework as well as a systematic approach to the process of designing characters for computer animation, aiding novice designers in their process of developing expertise.

This research organizes the information about the process of character design into a model – referred to as the Character Design Process Model – based on problem-solving and form generation processes. It was tested and refined using a constructivist approach in the creation of the main character, from “The Fox and the Grapes” animated short film. The model was also used as a framework for analysis of three applied studies of projects developed at the Advanced Computing Center for the Arts and Design.
The organization of information about character design within a systematic approach presents the interrelationships to new designers in a way that furthers their understanding of concepts and procedures related to the character design process. The analysis of practical applications of this body of knowledge consolidates that understanding and represents a set of references that will inform and enrich future experiences of novice designers.
Dedicated to my family.
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CHAPTER 1

INTRODUCTION

1.1 Expertise in character design for computer animation

Designing characters for 3D animation is an extremely valued activity by computer animation film studios. It is a very complex activity which demands a varied set of skills and holds the responsibility of creating the most important asset of an animation production. In order to create a character for an animated film, the designer has to manage information from the story, subjective concepts, references, visual style, visual elements, etc.

The proficiency and acquisition of expertise in this field depends on the practice and on the designer’s talent to develop this knowledge. The blog Character Design (http://characterdesign.blogspot.com/) often interviews expert character designers from across the globe. These interviews show that the majority of the designers have acquired their knowledge from the actual practice. Some even confess that what they know was self-taught and based on trial and error. Despite the fact this is totally legitimate means to develop expertise in arts and design, someone interested in becoming a professional in this field should have better and more efficient means to learn all the aspects of this activity.

Bryan Lawson is a design researcher who has been studying how designers think for almost 40 years. In his paper, Schemata, gambits and precedent: some factors in design expertise,
Lawson investigates the significance of experience in expertise and concludes identifying five necessary stages for the development of design expertise:

1. acquisition of the design domain schemata (schema is the organized basic body of knowledge which works as framework upon which the expertise will be built)
2. development of a growing pool of precedents (references)
3. identification of guiding principles (set of values and priorities that guide each project and is informed by experience – it can be style, philosophy, etc)
4. ability to recognize situations with little or no analysis
5. building a “repertoire of tricks” (design gambits – any possible way in which a recognized problem can be solved more quickly and efficiently)

Understanding what takes to be an expert in the general design field, may give an insight about the priorities a novice character designer should pursuit in order to develop expertise.

1.2 Lack of comprehensive information about character design process

Lawson also points out the importance of communication, shared experiences and understandings for the design expertise development. Having said that, the acquisition of schemata in the domain of character design, and ultimately the development of expertise is very challenging, because sharing experiences in such a field is very limited. At the time this thesis was written (2009) there was very little comprehensive information about the character
design process available. A survey at Amazon.com using the keyword “character design” reveals this gap in literature.

Considering the first fifty results (beyond this the titles were not available or they were repeated):

- thirty-three titles were “How-To” books
- nine were a collection of works in character design
- only eight touch the subject of character design process one way or another

Among these eight books:

- one was about production design
- one was specifically targeted for graphic novels
- two were specific for video game
- two were for character design in general, not targeted to any specific medium
- two explore the relationship between character design and story development

Traditionally, “How-To” books explore character design focusing only on one specific aspect of it. Some of the popular topics are related to style, anatomy, medium, drawing techniques, technical deliverables, etc. Although these topics are certainly related to the activity of designing characters, they are usually explored out of the context of a complete production.

On the other hand, “Art of” books usually reveal more aspects of the process behind the character design activity. The problem is that they tend to focus on the artistic
side of the process, lacking information about the reasons behind the exploration. This transforms the material, with otherwise great potential, into a mere art-work collection.

It is also possible to find information about character design in books about animation. The problem is that they never dedicate more than few paragraphs to the topic, which is often limited to situating where the character design process fits within the animation production pipeline.

Tony White, in *Animation: From Pencils to Pixels* gives insight about the reasons for the lack of literature about character design process. He states that creating a character is the most subjective activity a director has to contend with. According to him, it happens because character design is subjected to the personal taste of who is dealing with it at different stages of the development process (director, designer, animator, etc). Regardless the reason, the lack of studies about the character design process still represents a problem. What is the basic body of knowledge, and how does all the scattered information interrelate within the practice of character design? How does the development of these schemata help novice designers on the pursuit of expertise in character design?
1.3 Research Focus and Method

This research explores how the first two stages for a designer to become an expert – suggested by Bryan Lawson⁴ – apply to the character design domain. It establishes a cohesive framework as well as a systematic approach for designing characters for computer animation. It is expected that this material will represent a framework for the establishment of schemata and the collection of precedents, aiding novice character designers in the process of developing design expertise. In the same sense, this framework has the potential to be used as source for the curriculum development of a course specifically about character design, or more generic design practices.
First this thesis will gather and analyze information about character design (usually found scattered in literature). The material is organized and analyzed in regards to its relevance for the development of project parameters and procedures toward solutions. It will also point out basic aspects of the problem-solving process and general design concepts which the reader should already be familiar with, since these issues are extensively covered in design courses and design education books.

All this information is synthesized and interrelated within the character design process in the form of a suggested model that defines both methodical and creative aspects of the process – referred to as Character Design Process Model (Figure 1.1). To accomplish that, I adopted a constructivist approach in applying all the reviewed literature in the creation of the fox character, from *The Fox and the Grapes* animated short film. This approach relied on an ongoing process of discovery, analysis and intervention, using the problem-solving process and models of form generation as guidelines.

Last, this thesis will show three applied studies of projects developed at Advanced Computing Center for the Arts and Design (ACCAD). These studies use the Character Design Process Model as reference for the analysis.

The organization of information about character design within a systematic approach presents the interrelationships to new designers in a way that furthers their understanding of concepts and procedures related to the character design process. The analysis of practical applications of this body of knowledge consolidates that understanding and represents a set of references that will inform and enrich future experiences of novice designers.
Figure 1.2: Character Design Process Model
CHAPTER 2

BACKGROUND INFORMATION

2.1 Character Design

The character design process is intrinsically a process of embodying and visualizing ideas and concepts. Every decision the designer makes changes the set of possible solutions for the character design. Understanding what are the problems involved in the decision-making process and being aware of possible paths that the process can unfold through, will enable the designer to produce better solutions and grow in this career.

In Prepare to Board: Creating story and character for animated features and shorts, Nancy Beiman mentions: “Do anything you like” is the hardest assignment a character designer can ever have⁵. With her experience teaching character design, she noticed that students found it to be more difficult to design a character without limitations. In the professional field, it is rare that such task will be given to a designer. Perhaps, a character that doesn’t play any role in the story might be created without any parameters, just to fill in the background. However, even in those cases it is possible to have some design parameters in order to keep the style and aesthetic consistent to help with a visually balanced background.

In fact, Beiman says that “by narrowing the focus (using story constraints, names and descriptions as a framework), a set of limitations is created that become ‘liberations’”⁶. She
concludes stating that “a character in isolation […] is just a design. It is not a personality.”

She emphasizes that designing a character placed within a context is not only easier but it is also produces more meaningful results.

There is a relationship of interdependence between ‘character’ and ‘story’. Story influences the character development, and the character collaborates with the story understanding. This fact points out the importance of character design process within the storytelling production. As pointed out by Nancy Beiman, “a good character can be developed from a story [as well as] a good character can inspire the story”.

Regardless of the story format, “characters are what the audience follows in an emotional way: by loving them, hating them, or just being fascinated by them, but in any case, by identifying with them”.

2.1.1 Parameters

The limitations that guide the design process are the parameters. In other words, everything that influences the character look must be considered as a project parameter. As mentioned before, this kind of information can come from various sources. The most common sources of parameters for an animated film are the Story Synopsis, the Script, the Storyboard and the Character Description (also referred to as Character Briefing or Character Biography).

Just from a brief story synopsis there are already parameters that affect the character design, such as, for example, the story genre and the target audience. A horror story targeted for adult viewers cannot be rendered in a comic cartoon-like style, because the character
would have an inappropriate look to be scary. The story will directly and indirectly influence all the parameters for the development of character design.

From the analysis of the Script, the Storyboards, and also the animatics, a set of parameters can be established for the design that relates to the movements and actions the character will perform in the film. This set of parameters is known as Animation Requirements. Let us consider the simple example of a couple of characters that hug each other at some point in the film. Knowing that, the designer will take this information into consideration when deciding about the length of their arms. Ultimately, the design must collaborate with the character performance and not act against it.

The Character Description provides further information about the character and complements the parameters, which will guide the character design development. The description allows the designer to get familiar with the character to be designed. It reveals extra information about the character that is not necessarily directly related to the story. Background information, personality traits, helps the designer to thoroughly understand the character. These tend to be a very important set of parameters since it grants consistency and believability to the character design.

As Tom Bancroft reminds us\(^\text{10}\), the parameters will help the designer to formulate the design “boundaries”. Bancroft illustrates this point saying:
“If the hero is a somewhat shy introverted who needs to learn how to come out of his shell to win the day and the girl, you will be wasting your time drawing him as a large-chested, muscular, good-looking guy”.  

Although he encourages thinking outside the boundaries, he emphasizes the importance of knowing what you do not want to do and/or what you do not want to communicate.  

2.1.2 Developing Solutions

Once the parameters are set, how does the designer communicate them in the form of the visual solution? There are two important aspects to consider regarding the development of solutions for character design.

First, it is a methodical process, as it demands the investigation of problems and the transformation of findings into suitable solutions. The activity of designing a character is essentially a problem-solving process. Second, it is a purposeful and creative process, since designers have to give form to the characters satisfying the parameters with compelling visual forms. Because of that, most of the visual principles apply to the decision-making and problem-solving involved in this activity.

As mentioned by Hedgpeth and Missal, the ability to manipulate abstract visual elements, such as lines and shapes, into a unified, concise and recognizable form represents a challenge for the designer. However, as important as this ability is the designer must be able to define how the character is perceived, by using the design to address the problems posed by the story.
Hedgpeth and Missal point out that primary shapes should be used as an initial method for defining the basic character structure. They say they are “an effective tool for developing character recognition”.  

Nancy Beiman complements this theory stating that shapes have acquired symbolic meanings over the centuries. She uses as examples the fact that circular characters are often perceived as cute or non-threatening, while triangular shaped will make characters seem proactive or aggressive. Such ideas are also supported by Preston Blair with his categorization of characters appearance (Figures 2.1 and 2.2).

Figure 2.1: Square: (a) Solid, dependable; (b) strong, balanced; (c) unyielding, inflexible.


Figure 2.2: Preston Blair’s “Heavy Pugnacious” and “Cute” Characters categories.

These visual elements in characters are very common because they easily convey ideas and concepts. Stereotypes are used because of the same reason. However, Chris Patmore points out that stereotypes are conditioned to cultural aspects that might limit the character understanding. He suggests that for those cases, designers should investigate archetypes instead. Archetypes are the universal understanding of heroes, villains, mentors, guardians, among others, that exist in every culture.

It is important to realize that the design will influence the viewer’s understanding of the character and consequently the story. Characters have specific roles in the story, and their appearance has to support and be coherent with their role. Tom Bancroft compares a character designer with a casting director in live-action films. “In live-action [film], the casting director, meets with the director, then auditions actor after actor to find just the right ‘face’ and performance style for each role”.

2.2 The Problem-Solving Process

The problem-solving process is a series of activities to assist the creative process. This method has wide applicability in different fields of knowledge, being used both by artists, architects and designers, as well as marketing professionals, engineers, professors and researchers.

As a systematic approach, this process is used as a tool in planning and organizing a variety of activities and tasks that comprise the various phases of the creative activity. The problem-solving method can be structured in many ways, since it is customized to different objectives and constraints specific to each problem. Therefore, the designer is responsible for setting out and adapting the methodology, integrating the available information in order
to obtain the most suitable configuration to achieve a satisfactory solution to the design problem.

Figure 2.3 shows variations of this process illustrating how it can be adapted in order to fulfill the duties and restrictions of a specific problem. The complexity of the method may vary depending on the amount and accuracy of information available about the problem. For example, more complex problems may require a less linear structure, demanding that each step is revisited several times before reaching the final solution.

Figure 2.3: Three different problem-solving models


2.3 Form Generation

“How do the subject matter, skills, and materials interrelate with the process of creating or organizing new forms?”

This question, cited by Charles Wallschlaeger and Cynthia Busic-Snyder, has motivated educators in the visual arts throughout time to theorize about the human capability of generating forms. The basic understanding is that both two- and three-dimensional
compositions are created from the combination and manipulation of the elements of design, resulting in a picture or a tangible form which may be a piece of art, a product, or a building, or even a character for animation.

Considering that this body of knowledge is taught in any design course, and is widely available in literature, this thesis will only point out some topics that have deeper impact on the development of schemata for the character design domain.

2.3.1 Creation of shapes and forms

The process of creating images and forms involves the manipulation of basic visual elements, i.e. point, line and plane, integrating these elements with the principles of organization in order to obtain the desired composition or a three-dimensional structure. Points, for example, can be arranged in space in order to indicate direction, motion, depth, and distance. It can also determine the outline of a recognizable shape (Figure 2.4). This contour is obtained through a technique called closure.
Line is a crucial element in the creation and representation of form. Lines can add meaning, symbolism, and expression to visual forms, contributing to the communication of ideas, concepts, and moods, among other types of information (Figure 2.5). They can be used to define the limits of flat two-dimensional shapes or three-dimensional volumes. Using line drawing techniques, internal contours of the forms, tone, and texture can be visually created (Figure 2.6).
The plane is characterized by its shape, determined by the configuration of lines that set the limit of its contour. To obtain an adequate visual composition, creating the illusion of space and depth, it is crucial for the designer to know how to organize or align the planes in two-dimensional space (Figure 2.7). The full understanding of the perspective techniques is essential to create the illusion of depth and three-dimensional space from a two-dimensional image.
Designers use fundamental elements such as shape, volume and mass to describe the properties of three-dimensional objects. As with the plane, shape is the characteristic responsible for identification of volume. It is the outer limit/boundary of all the different views of a structure built by the plans and how they relate in space.

Drawing projection systems (orthographic, axonometric, oblique, and perspective), texture, tone, value or color can be used to create the illusion of volume in a two-dimensional picture plane. The base for the production of three-dimensional forms is simple two-dimensional planar shapes (polygons). These polygons can be organized in three dimensions, creating a network of planar faces (wireframes) structured in space.

2.3.2 Visual representation of form attributes

Tone, texture, pattern and color, for example, help define visual properties of the surface. Size, scale, dimension, proportion, and tactile texture, indicate visual and physical properties, because these aspects can be perceived visually and tactiley. All those attributes can be represented in many different ways in order to help viewers interpret the surface properties, and consequently, objects and forms.

Tone (or value) is a key attribute for representing visual aspects of a surface. It uses one-dimensional range of information, from black to white, to describe the lightness or darkness value of an image. Its variation can communicate visual texture and pattern. Tone can also be used to define edges and shapes of figures and forms by contrasting values with
the background or adjacent areas, communicating relative position, distance and depth (Figure 2.8). Tone is also applied to the representation of volume.

![Figure 2.8: Tone communicating distance and depth](image)

Size, scale, dimensions, and proportions, play important role within the design field. Size impacts the meaning of visual compositions, and can be used to communicate scale, depth, and distance. Proportion defines a relationship between parts and total of a physical form.¹⁹

**Golden Section**

The golden section (or golden mean) is one of the most used proportion system in History.²⁰ This ratio is associated to the natural “beauty” and the higher order of the universe. Therefore, at least since the Renaissance, artists have been relying on this system as a way to achieve beauty and visual order within their body of work (Figure 2.9).
Figure 2.9: The construction of a golden rectangle: from a regular square, use the diagonal from the middle point of the bottom line to the upper right corner of the square as a radius to draw an arc.

**Human Proportions**

Throughout history the search for the natural beauty has driven artists and intellectuals to rationalize the proportions and dimensions of the human body in many different ways. These proportions were often related to aesthetics rather than to the correctness of the dimensions of the human body. During the Renaissance, “human proportions were thought to be submultiples of the whole figure or of the face, or multiples of the small division of the height of the human figure”\(^{21}\) (Figure 2.10).

Figure 2.10: Leonardo da Vinci’s drawing of the human figure based on the Vitruvian proportions for “normal” adult size male
2.3.3 Color

Color is a light property. Psychologically, the perception of colors has the potential to influence and create moods, feelings, and associations. The visible range of color is known as color spectrum. Colors have three attributes: hue (the main visible wavelength of a color); value (or brightness); and saturation (or chroma is the intensity of hue in a specific color).

Primary colors are the basic set of colors that combined creates a range of colors. There are mainly two types of primaries: light primaries (projected directly from a light source) and pigment primaries (reflected from a surface into the eye). Secondary colors are achieved by mixing two primary colors. Color mixing depends on the type of colors are being mixed.

![Additive and subtractive color](image)

Figure 2.11: Additive and subtractive color
Color Balance

The visual balance perceived between hues is known as color harmonies. This perceptual balance is achieved by combining specific set colors as well as managing the proportion of one or another hue within a visual structure or composition. Harmonious color schemes rely on visually balanced relationships of the colors’ hue, value and saturation. These relationships should be used as “general guidelines to help develop color sight discernment and sensitivity skills in combining and applying colors”.

2.3.4 Perceiving Shapes and forms

There are many theories that describe shape and form perception. Visual tests by perception psychologists have revealed, among other factors, that interpretation of visual information relies on experience, culture, education, and learning environments.

The visual recognition process depends on the existence of contrast between the form and the background. The identification of some particular structural and surface aspects (i.e. contour or shape, color and/or value, spatial position, and movement, or lack thereof) helps the perception process of form.

Gestalt theory and visual perception

The Gestalt theory explores visual perception, memory and association, thinking and learning, social psychology, and the psychology of art. It explores organizational aspects of perception that would explain how and why the perception of the form in its totality differs from the perception of the form by its individual parts.
Law of Pragnanz

The law of Pragnanz dictates how the perceptual field is broken down into regular, orderly, symmetric, and simple visual information, making it easier to recognize. The resulting units of this “simplification” process of the perceptual field require less effort from the viewer to be perceived and understood (Figure 2.12).

![Figure 2.12: Complex shape broken down into simpler shapes](image)

Law of Closure

Law of Closure relates to visual continuity. It defines the tendency of the brain to promote the continuity of shapes in order to improve regularity and/or stability. In other words, a complex shape with irregular or discontinuous contour is synthesized to its simplest identifiable form and perceived as a whole figure (Figure 2.13).
Distinguishing Figure and Ground

In 1921, the perception psychologist Edgar Rubin defined seven differences or differentiations between figure and ground:

1. When two fields have a common border, it is the figure which seems to have shape while the ground does not.
2. The ground seems to extend behind the figure.
3. The figure appears to be object-like (even though it may be an abstract image) while the ground does not.
4. The color of the figure seems more substantial and solid than that of the ground.
5. The ground tends to be perceived as farther away and the figure nearer the observer even though both are obviously at the same distance.
6. The figure is more dominant and impressive and tends to be remembered more easily.
7. The common border between figure and ground is called contour, and the contour appears to be a property of figures.\textsuperscript{24}

More recent studies on visual perception have stated that the identification and differentiation between figure and ground depends mostly on contrast\textsuperscript{25}. The perception process relies on the contrast in value, color, texture, or depth cues to create the distinction between what is perceived as figure or ground. In addition, perception psychologists have also found out that figure enclosedness, closure, familiarity, and orientation are some of other figure properties that influence the perception of figures against a background (Figure 2.14).

![Figure 2.14: Figure enclosedness: A figure that is completely enclosed by a ground is more readily perceived as the figure](image)


2.3.5 Perceptual principles of Organization

Design process requires the understanding of visual structure in order to successfully organize visual information or forms into a unified and harmonious whole for interpretation.
by a particular audience. These visual structure (or syntax) in combination with previous experience of the perceiver (or receiver), construct meanings that induce multiple responses from the perceiver. The visual structure is, however, dependable of each of the visual principles or theories. The understanding of all those small parts contributes for their aggregation into the larger concept of “unity”, forming a whole visual message.

The creative form generation process should be guided by visual organizational principles. This will support the coherent association of the visual elements of form, the compositional elements, and the desired message, toward the creation of a visual unity.

**Visual Message and Form Generation**

Wallschlaeger and Busic-Snyder suggests that it is easier to understand the visual communication process by identifying theories, principles, and techniques that assist in solving visual problems:

- Communication theory: *helps structure the problem relative to the intended message and audience.*

- Semiotic theory (theory of signs): *assists in relating and describing relationships between signs and their referents.*

- Perception theory: *assists in laying the structural basis by identifying what viewers may perceive as recognizable figures.*

- Visual organization (perceiving the visual field, figure and form perception): *assist in structuring the relationships among the visual elements of form (point, line, shape, value, color, texture, and so on) to create the desired message.*
• Form aesthetics: define desirable intrinsic form qualities such as size, proportion and texture.
CHAPTER 3

CHARACTER DESIGN PROCESS

3.1 Character Design Process Model

Figure 3.1: Character Design Process Model
The Character Design Process Model is a reference tool intended to aid the problem-solving process related to the development of character design for computer animation. This model represents a collection of material from several different sources. The content related to character design process was gathered from books about animation production, character design, story development, and how-to and art-of books. Character design intended for computer animation is a product of a systematic approach to a series of problems. Therefore, a problem-solving process – commonly applied to the development of design methodologies – was used as structure for this model. A great deal of information about form generation applied to art and design was also employed to complement the understanding and development of this process.

The Character Design Process Model consists of two broader phases that guide the creation process: Preparative and Generative.

The Preparative phase contains two stages. One is Problem Definition, which is when the project itself and the main parameters for the project are established. This stage starts off the project by analyzing the Script and Storyboard and using this analysis to generate three categories of project parameters: Story Constrains; Animation Requirements; and Character Briefing. The other stage is Research, which serves to get the designer prepared for the process. In this stage the designer learns about the subject matter, gathers image references, and studies the precedents.

Second comes the Generative phase, which embodies two stages: Ideation and Refinement. In the Ideation stage, the designer will generate ideas (as many as possible) following the parameters as guidelines. The following stage, Refinement, consists of the process of refining the ideas that were generated during the Ideation stage and narrowing
them down to a possible design solution (or final character design concept). The last part of the Refinement stage encompasses the Implementation stage. It is when the final character design concept is translated to the three-dimensional environment.

3.1.1 Problem Definition/Project Set Up

As described by Tom Bancroft, in major animation studios, the character design process usually starts with the director(s) pitching the general story of the film with the aid of storyboards. This shows the importance of knowing the story before designing a character, and informs the process for the case of a small film production. A pitching session might not be necessary in a small production, but it is necessary for the designer to have a good understanding of the story and the character.

Beiman also remarks the importance of having a story concept before any drawing of the character is made. Story concept conveys the essence of the story and the character. This helps keeping the production focused, since all the solutions must be coherent with the story concept. Some examples of story concepts for famous animated films are:

- Flying elephant rescues mother and saves circus
- Heroic ogre saves princess from dragon and removes tyrannical king

The Character Description is the main source of information for the character. It usually presents a short biography of the character that commonly extrapolates what is showed in the actual story. But that enables the designer to visual explore subtle things about the personality or past experiences in the character design that makes it more believable for the viewer.
Next step is to find out how the story can affect the character design. In this case, a set of *Story Constraints* are helpful way to map this information out. Story Constraints are general information about aspects of the story and the overall project, which greatly influence the visual style adopted for the design. Some of these constraints are:

- Genre
- Targeted audience
- Timeframe

By analyzing (usually with the help of storyboards) both the Character Description and how the story develops into actions, it is possible to establish the *Animation Requirements*. This set of rules determines what design features allow the character to perform the actions expected from him on the story. Aspects from camera movements can also inform this set of requirements. Some examples of animation requirements are:

- How much movement the character will have
- What kind of movements the character will perform
- How expressive the movements are
- Relative position of the camera: close or far? From which angles?

**Parameters**

All the information gathered during the first stage of the project is compiled into a set of parameters. These parameters are a product of personal interpretation/analysis of how the Story Constraints, Animation Requirements and Character Briefing should inform the design.
In order to facilitate this analysis, the design is “broken down” into a set of primary visual attributes. Following a basic understanding of the form generation and visual perception processes, the design is divided into the following visual attributes:

1. Shape
2. Proportions
3. Physical attributes
4. Color

The relationships between the information input and the visual attributes of the design depend on the designer discretion, creativity and objectives of the project. However, organizing them into a matrix can help the designer to establish these relationships and define the parameters (Figure 3.2).

![Figure 3.2: Matrix system](image)

Figure 3.2: Matrix system
3.1.2 Research

A thorough investigation of all possible aspects of the object of representation enables the designer to be critical about the relevance of what is going to be translated into the design.

Research is a way to find references and inspiration to support the creative process. The designer might want to know what design solutions were used in the past for similar characters as reference. He or she might also find it helpful to look for inspirational imagery that relates to specific aspects of the design, such as a sample of texture that might inform a possible surfacing treatment solution or a specific facial proportion reference which communicates similar ideas the final design needs to convey.

For this Model, Concept Art is also being considered as part of the research stage. Traditionally it has been accepted as part of the Ideation stage, as Hedgepeth and Missal points out. The reason for the choice to associate the creation of Conceptual Art within the Research stage is that it does not necessarily take into consideration the set of parameters for the design. Rather, it serves as inspiration, just like any other research material, for the Ideation process. Conceptual art is a spontaneous exploration that helps the designer to establish a relationship with the character while seeking for insights (Figures 3.3–3.5).
3.1.3 Ideation

During the Ideation stage all the information gathered from various sources and in different forms is translated into concepts and ideas. This task requires as much research as it does drawing. As new ideas arise, research might be necessary to support the creative process with background and related information. It is important to generate as many variations of the ideas as possible (taking the opportunity to explore different styles as well) because they will be combined, expanded and refined in later stages to generate the final design.

A great deal of the work developed in the Ideation stage is empirical and subjective. The choices will always be subjected to the designer’s personal taste and/or interpretation of
the tasks in comparison to the parameters. In this sense, it is very important for the designer to be familiar with the object being designed. Tom Bancroft compared the designer’s and animator’s relationship with the characters: “if the animator has to be the character itself, the designer has to be the character’s best friend”\(^30\). This comparison emphasizes how important it is for the designer to know the character, its background, personality traits, flaws and virtues, etc. when translating these characteristics into visual features in the design (Figure 3.6).

![Figure 3.6: Ideation – visual exploration of ideas that communicate the character’s age](image)


Storyboards are a great tool to help not only the story and establishment of Animation Requirements, but also to inform the creative process to design the character. It is the first time the story beats are visualized, and that, very often brings up issues that were
not thought of before. Moreover, since there are no specific rules for storyboard complexity – other than being efficient in communicating the relationship among camera position, rough scene layout and story beats – it is also a good way to practice and experiment with style and quality of the shapes and movement.

3.1.3.1 Shape

The shape is one of the most significant design attribute in character design. Specifically considering a universe where there is more than one character. The overall shape is the first visual cue that differentiates one character from another. Moreover it adds substantial information about the character role in the story. Shape, combined with the aspects of Proportions and physical Attributes, promote the understanding of the silhouette. The silhouette, supported by the Gestalt theory, is another aspect of the design that benefits the understanding of the character.
3.1.3.2 Proportion

The body proportions are generally determined by the relationship between the size of the body and the size of the head of the character (Figure 3.8). They influence how the character is understood by the viewer. The manipulation of these relationships influences the style, making the character cartoon-like or realistic (Figure 3.8). It can also communicate the character’s age, sex, or even role in the story (Figure 3.9).
3.1.3.3 Physical Attributes

In general, the physical attributes relate to the detailing and physicality of the character. This visual attribute encompasses the process of adding the appropriate details to the character to make it convincing. From facial features to garments the character would wear. It also includes all types of visual treatments for communicating these details, such as texture, patterns, and so on.
3.1.3.4  Color

Color helps to communicate the character identity. It establishes a relationship between the character and the background, supporting the unity and recognition of the
character’s silhouette (Figure 3.12). Color can also define the characters role in the story (Figure 3.13); can be manipulated to communicate the characters mood; or how the character is perceived throughout the story (Figure 3.14).

Figure 3.12: Color promoting contrast with background


Figure 3.13: Identity through color – warm and cold colors suggest the characters’ role in the story


Figure 3.14: Color changing how character is perceived in the story

3.1.4 Refinement

In the Refinement stage the ideas generated in the Ideation stage will be evaluated according to how they address the parameters and then some are combined and refined. As observed by Tom Bancroft “the director of a project will like parts of three or four different drawings [created in the Ideation stage]. The director will then ask a designer [in the Refinement stage] to come in and combine them in a cohesive design together.”31 The refinement process includes the creation of the character in various poses and postures (especially extreme poses which take the design to the limit), and also with different facial expressions. This method enables the designer to evaluate how the design behaves to the distorted physical attributes and the level of recognition of the design after the deformation.

After going through the refinement process on the traditional media (pencil and paper), the final concept is taken into the digital three-dimensional environment. This process, called Implementation, represents the refinement stage in a different level of complexity, where all the visual principles will now be applied to the modeling, texturing (or surfacing) and rigging.
3.1.4.1 Facial Expressions

The Refinement process for facial expressions is closely related to the development of Physical Attributes. It is actually an application of the physical attributes to a character's context. This specific exploration tests and refines the facial elements, making sure that the elements previously proposed work in all the needed situations. The facial elements are taken to extreme positions and expressions, preferably within contexts of the film. The other benefit is that after establishing a variety of different facial expressions we have a set of reference for keeping it consistent while animating the character.
3.1.4.2 Body Posture

Like the facial expression, Body Posture is also an application of the Physical Attributes to different contexts. First, it verifies and confirms that the elements proposed as physical attributes work in all the desirable situations (Figures 3.18 and 3.19). Similar to the method applied to the facial expressions, the body is taken to extreme positions, considering the actions and movements it will perform throughout the film. It also establishes a body language particular to the character that will help maintaining it consistent during the animation process.
3.1.4.3 Implementation: 2-D to 3-D

After the refinement process, once the final character design concept is accepted, the designer will create Model Sheets. The Model Sheets are the character concept documentation, and provides references for modeling, texturing and animation.

Model Sheets were inherited from the traditional animation. Animators needed strong guidelines for reproducing and animating by hand the same character over and over,
making sure the design would be consistent throughout the entire animation. There were many types of model sheets that served for different purposes, but now only some are still important in CG animation:

- **Character Model Sheet**: provides several different orthographic views of the character and texturing reference (still relevant document for computer animated productions) (Figure 3.20)
- **Construction Model Sheet**: breakdown of the design into its component shapes (Figure 3.21)
- **Clean Up Model Sheet**: establishes line and finishing quality
- **Action Model Sheet**: depicts typical movements and expressions, often found separately in Posing Sheet and Expression Sheet (Figure 3.22)
- **Character Lineup**: all characters aligned in the same scale (still relevant document for computer animated productions) (Figure 3.23)
Figure 3.20: Character Model Sheet


Figure 3.21: Construction Model Sheet


Figure 3.22: Action Model Sheet

In the digital environment, the translation process from two-dimensional design concept into a three-dimensional computer model represents a restart of the refinement stage. All the issues dealt with when consolidating the design in the two-dimensional representation, now have to be revisited and make sure the same design comes through, but now with three dimensions.

Issues such as depth perception, camera/perspective distortions, and shading affect how the design is perceived in the three-dimensional environment. Also, disregarding the style, or level of stylization, two-dimensional media is generally more tolerant of topographical inconsistencies of representations than three-dimensional representations. That means that sometimes a certain detail, or a complex intersection of irregular shapes, that was simplified by the designer in the design concept, is likely to look different within the three-dimensional model.

Figure 3.24 shows the comparison of the 2D concept and the final 3D model. Modeling stage usually starts using the orthographic views from the Character Model sheet as reference, however there are many ways and techniques this stage evolves to achieve the
design. In larger environments, it is very common for the art director to make notes on top of prints of the models to communicate what needs to be refined (Figure 3.25 and 3.26).

Figure 3.24: The facial proportions and the shape of the hair got refined in the 3D environment

There are still a few animation studios that build physical three-dimensional models, prior to computer modeling (Figure 3.27). This extra step in the process aided the modeling process by benefitting from the tactile aspect and by removing issues related to the depth perception. However, the development of new digital modeling tools and techniques, this process is becoming easier and more intuitive. In addition to that, the competition in the career has forced modelers to become better prepared for the market, achieving an outstanding level of quality. Consequently, it led the majority of the studios to consider the physical sculpting step as no longer necessary.
The texturing stage starts once the final three-dimensional model is finished. The addition of volume information to the design raises issues with shadows, highlights, and the overall surface material properties. These issues affect how colors are displayed and can change the character's identity, which usually demands a combined solution between the compensation of the color on the character's surface and the lighting setup. The underlying rig of the character is built at the same time. This structural system that enables the character to be animated takes into consideration the movements the character needs to perform. Once the character has its final texture and final rig applied to the model, it is ready to be applied to the rest of the animation pipeline.
CHAPTER 4

APPLIED STUDIES

4.1 *DripDry*

Project Description

*DripDry* is a short animated film developed in the Ohio State University 2007 Winter Quarter Procedural Animation class. This twelve week class was a multidisciplinary effort between the Design Department and the Department of Computer Science and Engineering. This project based class was supervised by Maria Palazzi (ACCAD – Design Department) and Rick Parent (Department of Computer Science and Engineering).

The purpose of this class was to provide the students with a collaborative and multidisciplinary learning experience, exploring the real scenario of an animation production. Students from the Design Department and from the Department of Computer and Science Engineering team up to learn about the means, techniques and communication skills necessary for the success of an animation production. Although the class evolved depending upon the challenges proposed by each team’s animation, the learning process was supported by lectures about the production of an animation. They explored artistic topics
such as storyboards, aesthetics, and animatics as well as technical, such as procedural animation techniques.

The *DripDry* animation team was composed of six members, four CSE students; Jonathan Eisenmann, John Loy, Matt Wyckhouse and Ying Wei & two designers; Beth Albright and myself. The story concept was suggested by J. Eisenmann while the group collaborated with ideas for the story development. Beth Albright and I were responsible for art directing, building assets and animating everything not procedurally animated. The CSE members were responsible for programming and developing the effects.

*Synopsis*

*DripDry* is a modern tale about survival. It tells the adventure of little guys made of water droplets in a great big world, the bottom of a kitchen sink. A “larger-than-life” sponge menaces their existence and they must pull together (literally) and think fast to find a way to stay alive.

*Story Treatment/Storyboard*
Open on a medium shot of the kitchen sink. The faucet is dripping.

Instead of dripping down the drain the droplets rebound off the sink surface as little rigid spheres.

The spheres assemble themselves into a Little Water-guy, who begins to wander and explore around the sink.

The faucet continues to drip creating more Little Water-guys that wander the sink.

One of them knocks over a cup, which makes a loud noise; they jump in reaction and see a long shadow suddenly looming down over them.
• The Sponge jumps down into the sink and begins to chase the Little Water-guys, easily capturing a slow chubby one and chomping with great satisfaction.

• The Little Water-guys scatter away in panic and smack into the corner of the sink, causing them to splash together into a puddle.

Figure 4.2: Storyboard Panels 16 to 30

• The puddle re-forms into larger spheres which make a Big Water-guy. The Sponge is confused, then angry at this turn of events.

• The Big Water-guy looks down and sees a sprayer nozzle, which he picks up and aims at the Sponge.

• As the Sponge advances toward the Big Water-guy, the Big Water-guy turns on the sprayer and blasts the Sponge.

• The Sponge swells as it absorbs the water, and is stopped in its tracks.

• Then the water fails to spray out of the hose, it was just what was left in the hose. Now the Sponge is dripping wet and furious.
Figure 4.3: Storyboards panels 31 to 45

- The Big Water-guy looks around frantically as the Sponge advances toward him, and notices that the Sponge is dripping wet because it is fully saturated with water.

- This gives the Big Water-guy an idea, as the Sponge leaps toward him he will leap forward as well.

Figure 4.4: Storyboard panels 46 to 60

- The camera pans around in a slow-motion 360 degree arc as both figures fly toward each other.
• The Big Water-guy is melding into one liquidy glob as he flies forward.

• He dives directly into the Sponge, knocking it backward. The Sponge then begins to ripple and crack.

• The Sponge explodes into a million pieces! What remains is the Big Water-guy standing in the sink.

• When he realizes he's defeated the Sponge, he begins to dance around in celebration.

• The Big Water-guy gets a little too excited and slips because of his wet feet.

Figure 4.5: Storyboard panels 60 to 67

• The camera reveals the Big Water-guy fell into the drain.

• Despite all the Big Water-guy efforts, he cannot prevent himself from going down the drain.
• After a few moments, more Little Water-guys appear around the drain, looking curious.

• The camera follows the dripping water back to the faucet.

**Project Setup**

The entire project had a very tight schedule. As a group we immediately had to define what the story and the characters were going to be, and find out what our production needs were. After a brainstorming session we decided the major special effect on our animation would be the simulation of water. Therefore, we decided the main character was going to be made of water so we could apply the effects as much as possible. The design process was intertwined with the story development with the support of the story-boards. New ideas for the story would require new features for the design and vice-versa.

From the brainstorming session we came up with a list of events and actions for the story which was used as guidelines for the storyboard and story refinement. We then analyzed what actions each character needed to perform and the procedural effects involved in their actions and design. Based on this analysis we established a series of parameters to guide each of the characters’ design development. Finally, we consolidated the story outline and the character parameters into an asset list for modeling and effects. This was important for the production since it enabled each team member to work in parallel in different areas of the project.

The team’s goal was to conclude the character design stage in two weeks including rough models. The final rigged models were scheduled to be completed three weeks after
that. Due to the amount of work and tight schedule we decided Beth Albright would be responsible for creating the water-guys and I would be responsible for the Sponge. Because we had two people capable of creating characters on our team we were able to optimize the production.

**Character Description/Briefing**

- **Little Water-guys**

  Little Water-guys are curious beings. They are most commonly found playing on hard and smooth surfaces typically close to dripping faucets, vapors or large masses of water. These characters like to explore unusual places and touch every possible surface. These clumsy creatures cannot control their direction very well. They typically bump into obstacles in their way and into each other. They are usually tiny, but when they bump into each other they merge into larger water-guys.

- **Big Water-guy**

  The Big Water-guy is the result of the union of all the little water-guys, adding to each other’s volume and strength. The Big Water-guy also inherits their clumsiness, which is often dangerous to his existence, especially if there are drainers around them.

- **Sponge**

  The Sponge is an evil and disturbed being. The Sponge’s uncontrollable desire to fulfill the reason of its existence – to keep every visible surface clean and dry – is the agony of the Little Water-guys. Many believe the Sponge suffers from OCD, however, this has
never been professionally confirmed. What is known is that this creature acts irrationally, and
doesn’t understand the concept of compassion or guilt. This fact makes the Sponge even
more dangerous for the Little Water-guys.

**Parameters**

**Overall**

- Consistent design among the water characters to communicate the idea of
  unity and family
- Contrast between the water characters design and the sponge design

**Little Water-guys**

- Procedurally created
- Ability to merge themselves and morph into the Big Water-guy
- Simple
- Stylized
- Bright colors
- Children/Cute and harmless
- Clumsy
- Vulnerable looking
- Droplet like

**Big Water-guy**

- Procedurally created
• Ability to merge the design into one big water glob
• Simple
• Stylized
• Bright colors
• Male adult proportions
• Strong

*Sponge*

• Features from real kitchen sponge
• Ability to change the design from skinny to fat
• Simple
• Stylized
• Menacing and scary looking
• Male adult proportions
• Strong

**Ideation and Refinement**

The team envisioned the style to be cartoon like. All the early concepts were very stylized (Figure 4.6), with a high level of abstraction of details and overall shapes, and also making use of a large gamut of saturated colors with thick outlines defining the forms. Everyone agreed this approach would emphasize the comical nature of the story, and it would also help set up the viewers’ expectations for what the film was going to be.
Moreover, the style dictated the level of abstraction in which the character designs were supposed to fit.

![Figure 4.6: Concept art for the environment](image)

As mentioned before, since the story was supposed to be driven by the characters’ traits and capabilities, there were a great deal of information exchange between the story development and the character designs development. One of the things which the story informed the characters’ design was the size relationship among characters. Each character has a specific role in the story and their size helped communicate this. The Little Water-guys were an annoyance for the Sponge, like fleas. The Sponge, on the other hand, is the threat because his size represents how many Little Water-guys he can “eat” (absorb). The Big Water-guy represents the union of the little beings and a fair opponent for the Sponge.
The characters size was just one way to visually express their relationship. We also used visual elements to reinforce the opposition between the main characters in the story. That was solved by exploring contrasting shapes, colors, proportions, and even subjective meanings embedded into all of the above.

The basic concept for the water characters was induced by a technical constraint. One of the parameters for the character was that it was going to be procedurally formed. The technical solution was that spheres could be procedurally moved around without geometry intersection issues – since its boundary can be easily calculated. Because of that we decided to make the water characters body an arrangement of several spheres, and they fit in the story as being water droplets. This solution responded to all of the parameters very efficiently. The water drops when combined to form the characters would ensure consistency between the water-guys’ design, guaranteeing they were identified as a group. Moreover, the design would become very abstract, simple and stylized.

Based on Preston Blair’s system for categorizing appealing characters, the Little Water-guy’s anatomic proportions were designed to fit “The Cute Character” (Figure 4.7). According to Blair, the basic proportions of a baby convey the qualities of cute, shy, or coy. He also states that the small body in relation to the large head plus the rounded shapes implies a physical weakness and lack of aggressivity.
For the Big Water-guy, the concept was the same; however, it was used an adult anatomical proportions to influence the understanding of the character. The large chest and thin waist and hips, forming an inverted triangle, convey the idea of strength and masculinity (Figure 4.8). The spheres forming the arms and legs resemble also bulgy muscles, which reinforces the idea of strength. The inspiration is that the Big Water-guy is the guardian – possibly the father or the older brother – of the little ones, who will protect them from the Sponge.
There were different thoughts for what the Sponge character could look like. The range was from anthropomorphic representation with arms and legs to a brick shape characteristic of a kitchen sponge (Figure 4.9). The idea of disguising the character's eyes and mouth into the sponge texture was consistent throughout the concepts. One interesting aspect of the character, which was important for the story and fundamental for the design, was that in the end the Sponge's shape would have to morph into a fat figure to represent the sponge soaked in water.

Figure 4.9: Concepts for the Sponge characters
The “brick shape” concept was chosen based on the idea the sponge had to be the nemesis of the Big Water-guy in all possible aspects. In order to add more personality to the character, the design follows some of the principles stated by Preston Blair for the “The Heavy, Pugnacious Character”. When the Sponge is dry its shape resembles the body, with the top part being larger than the bottom to suggest the idea of strength and masculinity. The character soaked in water would have bottom larger than the top, to suggest his belly getting fat. On this version, the Sponge resembles Blair’s “Heavy, Pugnacious Character” face, with small cranium huge chin and jaws. The heavy eyebrows, the eyes close and beady, with the big lower lip sticking out were kept as a trace of identity for the character (Figure 4.10). The texture would be represented by oversized holes spread around its body. The holes were placed in strategic locations to make up the character’s eyes and mouth.

Figure 4.10: Preston Blair's "Pugnacious Character" informed features of the Sponge design
The decision for a cartoon like style created a challenge for the type of visual treatment we were going to explore for the characters’ surfacing. For the water characters, the challenge was how to visually represent water, and make it convincing without making it look realistic. The water shader exploration evolved around simplicity in color variation and details. The visual interest and complexity would be achieved by the repetition and pattern created by the multiple spheres composing the character’s body (Figures 4.11 and 4.12).

![Figure 4.11: Little Water-guy character](image1)

![Figure 4.12: Big Water-guy](image2)

Both characters’ concepts satisfied the established parameters and also met the need for them to visually oppose each other in many ways. The primary shape of the water characters is a sphere while the Sponge is a square. The water characters are formed by organized light blue spheres, while the Sponge is fragmentized by chaotic black circles. The primary color used on the characters surfacing was also expected to accentuate the contrast between them.

At the same time the characters were being developed, all the events and actions of the story were being refined through the storyboard and the animatic. The animatic went
through a few iterations until we were satisfied with the story pace. Our main concern with
the animatics was to get the timing for all the scenes corrected and be able to start animating
as soon as the characters were finished.

**Implementation**

Implementation is the phase the character design concepts were translated from 2D
to 3D, prepared for animation and placed in the set. During this phase the major concern
was to adjust and refine the designs to work in the 3D environment. More specifically, it
consisted of:

1. Modeling the characters;
2. Adjusting the designs to compensate the depth/volume perception, intrinsic
to the three-dimensional environment in achieving the desirable volume and
shape defined by the design concepts;
3. Consolidating the size relationship among the characters, and the set;
4. Implementing the rigging system.

These characters did not present any challenge for modeling because of the
simplicity of their design. Although the overall solutions were very straight forward in how
they were going to be implemented in 3D, the Sponge character demanded a little more
planning. Since the solution was to use Blend Shapes to make the transition from its
slim/dry version to fat/wet, it was necessary to ensure both models had the same amount of
vertices. That was easily solved by using a common low-poly mesh as base for both models,
and making sure they had the same subdivision level after all.
Also because of the simplicity of the solutions there were little adjustments to be done to fix issues caused by the depth perception. The Sponge character was made slightly larger than the design concept. Since the volume is distributed in space, its perception is affected by perspective. All the dimensions “get smaller” as they move away from the camera and toward the vanishing point, this makes the characters silhouette appear slimmer.

As mentioned before, the characters size relationship was defined by their role and actions in the story. Since the Little Water-guys had to look and behave as crowd that morphs into the Big Water-guy, they presented an extra level of complexity in choosing their right size. The parameters to make them as small as possible were:

- They had to be big enough so the viewer can identify their shapes and movements when they are in scene with the other two big characters;
- There had to be as many as possible of them in the crowd;
- The total mass had to convincingly transfer from the crowd of Little Water-guys to the Big Water-guy.

The Big Water-guy had to be the same size as the Sponge. The Sponge’s guidelines for size were of a real sponge (approximately 3.5 inches tall by 2.5 inches wide), which would also guide the size relationship of the characters to the environment. After the adjustments the final Character Lineup can be observed on Figure 4.13.
The Sponge’s texture also needed some extra thought. The approved texture applied on the model made the character look more like a piece of cheese than a yellow kitchen sponge (Figure 4.13). Two options were considered to solve this problem; one was to increase the amount of detail in his texture to represent more realistically a sponge surface, another was to add an element to the design found exclusively on kitchen sponges. The solution adopted was to add the dark green layer typical on heavy-duty sponges on the back part of the character. It was also assumed that the story context and environment would help the viewers to understand the character.

Rigging a character is a very complex process which involves several steps and different techniques. For most of the students involved in this project, setting up a rigging system was definitely new ground; because of this it was very hard to overcome the steep learning curve in the time available. The solution was to keep the rigging systems as simple and functional as possible, just enough to enable the characters to perform their main actions. We also had valuable insights from Daniel Guinn, who helped us get started with the
characters’ setups. In the end the design was not affected by the rig or the technical limitation on setting it up, and we managed to finish the rig in one week.

4.2 *The Bakery Shop* - Econ Game

**Project Description**

“The Bakery Shop” ([http://www.thebakeryshop.org](http://www.thebakeryshop.org)) is an educational game developed at ACCAD in 2008, in a partnership with the Ohio Council for Economic Education (OCEE) and WOSU Public Media. My role as the Concept Artist required creating the game visual concept, designing the characters and background during the Conceptualization Stage.

The purpose of the game is to teach concepts of economics to second graders in a visually engaging way, using the entertaining game context. The game is intended be used in the classroom by teachers as a supplement to their lessons or as an independent experience on the web for children. These economic concepts in the game should enable children to explain how resources can be used in various ways, identify goods and services, and recognize money as the generally accepted medium of exchange for goods and services.

The educational game project was intended to be completed in one year. The building process was divided in two main stages: Conceptualization and Production. I participated in The Conceptualization Stage which lasted for three months at a part-time level of work. This stage was broken down into:

1.) Setting up parameters for the project

2.) Brainstorming different solutions for the game
3.) Creating visual ideas for characters and background

Following this stage we presented the game’s concept to the WOSU and OCEE to be critiqued and approved. This presentation not only represented a deadline for the conceptualization stage, but also as a milestone to start the Production Stage. The educational game was built, tested and refined in the Production Stage.

"The Bakery Shop" Game Description

Streams of hungry customers arrive at a bakery with a specific craving. Ingredients, cooks, and ovens must be carefully managed to produce the right food at the right time to keep customers happy. The goods produced by the bakery share similar ingredients, so choice is important and is always a trade-off between recipes.

The game is presented in a 3rd person isometric view. The whole environment will always be on screen, allowing the player to easily monitor what's going on at any given moment. Interactivity with the game is mouse driven and occurs directly with the environment. For example, the player will click on the ingredient boxes in the kitchen to purchase more, or click on a baker to direct them to follow a certain recipe.

Time in the game progresses at a much faster pace than real life; a full day lasts only minutes in the game; a full game goes on for several day and night cycles until the player can no longer generate enough revenue to afford baking supplies and store overhead. Customer satisfaction is tallied during the day, and drives the value of a nightly cash bonus that can be used to purchase enhancements for the bakery or saved for future use.
Project Setup

In the first stage, my focus was on creating ideas for the game context and developing them into content and gameflow. In a later stage, I would be also responsible for defining guidelines for the game visuals, with emphasis specifically on the character design.

Peter Gerstmann the Project Lead and I brainstormed roughly how the game would be structured. The main idea was that the game would focus on the people’s needs. All the other game elements would be a result of “trying to meet their needs”. This principle enabled us a variety of methods to work on the concepts of demand, overhead expenses, business choices, and the concept of money.

A variety of ideas for the Bakery Shop game’s context were explored during the brainstorming session. One concept was Outer Space, where the player would have to gather supplies from other planets for survival (Figure 4.14). Another context concept was an imaginary world, in which people would live on the top of mountains, and they would have to travel by building bridges connecting the mountain tops to find new resources (Figure 4.15). The third concept was a kitchen environment, in which the player would have to cook, and buy the necessary kitchen supplies as they are needed (Figure 4.16).
The context we thought was most appropriate was the kitchen environment. Bringing the customer’s needs to the player’s attention, enabled us to address the economic concept in a more straight forward and practical method. This choice made the concept of commerce a much easier concept to grasp for the students without implying the concept in an unhealthy supply extraction from non renewable resources. If we worked with the gathering ingredients methods then we would have to address the concept of replanting and responsible harvesting which is an entirely separate concept in its self.

The major limitation with the kitchen context was the lack of a stronger motivation for the player to engage in the game. Another brainstorming session followed in order to further develop this context and restructure the game objectives. Keeping the same environment, we expanded the concept to an open environment restaurant kitchen. The idea was that the player would still have control over the person cooking, but now there would be the visual pressure of the customers ordering, waiting in line and being frustrated waiting for their food. Now the main objective would be to keep them happy by serving the customer quickly, and correctly.
In this new context there were several ways in which the game play would become more engaging and interesting for the player. We could vary the amount of orders in a certain span of time, limit the amount of supplies, and limit the number of cooks or ovens, and so on. These factors would force the players to analyze the patterns and establish different strategies for different situations, making the game more challenging and fun to play.

Over time, the idea of the restaurant kitchen evolved to the Bakery for two reasons. One was to reduce the amount of ingredients required for the baked goods, and make it a more realistic and manageable environment. The other reason was to limit the amount of time the customers would be willing to wait for the fresh goods. Once this was achieved the games concept became more realistic and stable also enabling us to define parameters for the characters design.

**Character Description/Briefing**

- **Customers**

  During the day, customers approach the bakery craving a specific food item. Customer traffic peaks at typical meal times causing differences in the pace of the game. Once a customer stands in line, they start loosing patience waiting for their craving to be serviced. Customers become dissatisfied when they are made to wait too long, and will leave the line in a bad mood when their patience runs out. Total customer happiness is recorded over the course of the day and determines a nightly cash bonus for the bakery.
• **Bakers**

Bakers must complete the recipes and deliver the goods before the customer's patience runs out. For maximum customer satisfaction, the recipes must be completed in before the customer arrives at the counter. Bakers complete the recipes/orders in several steps:

1.) mixing ingredients
2.) baking in an oven
3.) delivering to the counter

They can also cancel recipes at any time during their completion at the cost of the ingredients already used.

**Parameters**

It is important to notice that several of the parameters involved combining the exploration of characters and the background since they were intertwined on the game play.

**Overall**

• Visual consistency between Character and Background
• Combination of character size and environment space to allow smooth flow of customers crowd
• Small characters to allow the formation of a crowd
• Modular and interchangeable characters and background parts for game graphics optimizations
• All elements should be visible and identifiable at all times, even when overlapping, to improve playability
• Characters should be able to walk to all locations
• Visually appealing to second graders

Customers
• Each individual must be visually different to help the player memorize each order
• Variety of skin and clothing colors to imply diversity
• Readable facial expressions to express satisfaction level

Bakers
• Variety of skin color to imply diversity
• Uniform to show unity and differentiate from costumers

Research
The design process was started by researching existing games and analyzing them from three different priorities that guided our design choices:

• Economics simulation games
• Visual style
• Addictive game-play.
Economics simulation games

Games of this nature consist of performing a sequence of tasks in the correct order. The challenge is to figure out patterns to optimize your actions and supplies in an effort to achieve better results. Some of the games analyzed were very tiring and frustrating because they had a very complex set of instructions with an interface that is not intuitive enough to understand how to succeed. Coffee Tycoon (http://www.coffeetycoon.net/demo) is just one example of the complicated games found available (Figure 4.17). After analyzing these games we determined our objectives and priorities should be:

- clear and effective instructions
- intuitive game-play
- Easily recognizable elements
- Clear function and roles for elements
- Actions based on natural and common-sense expectations (this would demand user testing to verify reliability)

Figure 4.17: screen grabs from Coffee Tycoon
**Visual Style:**

The research showed us that too much visual information without visual priorities makes the environment disorienting and difficult to play. *Nanny Mania* ([http://www.gamefools.com/onlinegames/free/NannyMania.html](http://www.gamefools.com/onlinegames/free/NannyMania.html)) is an example of a visually cluttered game to the point that it is difficult to identify the characters. However, this cluttering effect could be explored to vary the difficulty levels in the game (Figure 4.18).

![Figure 4.18: Screen grabs from Nanny Mania](image)

One quality we observed in some examples was how colors were used. Colors should promote good contrast between the elements and the background, improving the player’s overall understanding of the elements, and making it visually pleasant and balanced. A good example usage of colors is in *Isometric Game Engine*[^33^], which is a demo version used as proof of concept for a discovery game (Figure 4.19).
Most of the examples analyzed have employed a simulated perspective based on the axonometric projection. Functionally, this was very effective in informing distance in this type of game, where characters have to navigate through space. In this type of visual representation, one unit of distance is always going to be the same size on screen, no matter if it is close or further away from the point of view. They don’t vary through space because parallel lines are represented as parallels, keeping the same measurement. This is different from perspective representations in which parallel lines collapse in the vanishing point, changing the measurement of elements accordingly to where it is located along these lines (Figure 4.20).
Figure 4.21 shows two overlapped figures represented in 3-point perspective in Figure 4.20, proving that, despite the scale issue, their shapes change depending on where it is located on the drawing.

Figure 4.21: Overlapped figures shows how perspective drawing deforms the shape of the object
In this sense, the Axonometric Projection benefits the game coding because of its modularity aspect. Since the dimensions and shapes of elements are kept the same in any coordinate, they can be easily placed on a grid and used multiple times in any location. It also drastically reduces the computational demand of the game because it is able to use these elements as assets, and reutilizing them applicable. Instead of having fifteen different characters, there would be just one or two in which their heads would be replaced for unique ones or the background could be composed of a combination of tiles.

Some guidelines for the visual style are:

- Use the variation of number of elements for varying difficulty levels
- Combine color in elements to achieve contrast and visual interest
- Explore axonometric projection to sustain modularity

**Addictive Game-play:**

Research taught us the importance of variance in the game-play rhythm, and also how a clear objective, or mission, improves the levels of engagement on the game. Desktop Tower Defense (http://www.handdrawngames.com/DesktopTD/Game.asp), although extremely simple, is a very addicting game because it utilizes quick pacing combined with careful planning and resource management (Figure 4.22). The player focuses on how to combine different elements in order to achieve better results. Each time the way you combine the pieces is different, the speed the player has to respond to the cues also varies throughout the game. By having a simple and clear objective makes this game a very interesting and addicting game to play.

Some guidelines learned from the analysis of this type of game are:
• Varying game pacing
• Clear objectives
• Clear instructions
• Simple commands
• Focus on procedure to achieve success (strategy)

Figure 4.22: Desktop Tower Defense

Ideation

The Ideation stage started with the analysis of how the game engine would influence the design. There was one interesting aspect of it which we had to take in consideration. The elements’ spatial placement needed to be aligned on a grid based on coordinates of X and Y. Therefore, characters were limited to move in the four cardinal directions, North, South, East and West. Moreover, the grid determined the minimum size of a graphics tile,
informing the modularity aspect of the game elements. If the tiles were smaller than the grid unit, there would be a gap between two adjacent tiles. If the tile were bigger than the grid unit, we would see an overlap between two adjacent tiles.

The grid was an underlying guideline for the graphics; with a little creativity we were able to match lines from axonometric projections with the grid to simulate perspective (Figure 4.23) in order to make the graphic more interesting.

![Figure 4.23: Two types of oblique pictorial representation on grid](image)

The only aspect remaining was to choose which overlapping elements were the most visible and develop a solution. The main concern was how the character’s facial expression would be visible in any situation. Testing the character using the two axonometric pictorial representations we were able to choose the best option to address this problem (Figure 4.24).
This was also a good chance to explore different proportions for the character. We decided to use the taller character because it needed to be at least two units tall to stand next to the counter with an item on top and still be visible behind it. Another reason was that being able to animate the character’s legs would add more interest to the game. Once that was decided, it determined the grid unit dimensions in order to enable the desirable graphics arrangements on the screen (Figure 4.25). Based on those decisions we created a rough concept of how the game layout could be (Figure 4.26).
We created a few mockups in order to evaluate how the graphics would appear in different sizes of grids (Figure 4.27). The first criterion was the best ratio of the smallest size a character could have but still having his facial features easily readable from the regular sitting position in front of the computer. The second criterion was it couldn’t be so small that would be hard to click on top of a moving character.

Figure 4.25: Grid and Coordinate positions for each element

Figure 4.26: First rough concept

Figure 4.27: Graphics scale evaluation
Based on those criteria we chose the first as being the best solution for the scale. With bigger characters we would be able to be more expressive on their animations, and it would be easier for the players to click on the characters. This would also fill in the screen better optimizing the usage of the area we had available.

Established dimensions for the main elements:

- Game Screen dimensions = 900px width X 600px Height;
- Grid = 30px Width X 30px Height;
- Character dimensions = 60px Width X 120px Height (Figure 4.28);
- Graphic tile dimensions (rectangle which contains the basic “cube” figure) = 60px Width X 90px Height (Figure 4.29).

Knowing the correct dimensions of the tiles on screen, we could start being more specific about the design exploration for the graphic elements (characters, background tiles, scene elements, user interface, etc).

We started adding more detail to the face. After the first studies we thought the rounded shaped face was a strong solution. It was easily identifiable within the crowd since that rounded shape would always be visible, first because of the never-overlapping solution
found the characters face (Figure 4.24). Also because the rounded shape would offer good contrast with the hard edges from the background elements based on the axonometric projection.

Defining the physical attributes for the face was not as straightforward, but a solution with fewer details was chosen (Figure 4.30). The solution was more graphical, almost iconic. We discovered that using shadows, volumes and more detail would make it more complicated to apply the facial animation. This single choice represented a hint of the direction of the style being developed. After that the emotional range from happy to sad was developed. It was important to emphasize the two ends of the range in order to clearly communicate to the player when it had reached the limit on both spectrums (Figure 4.31).

![Facial features exploration](image1)

**Figure 4.30: Facial features exploration**

![Facial expressions](image2)

**Figure 4.31: Facial expressions**

Ultimately, as a solution for the modularity issue, the head would be one of the assets. It would be reused on all characters, and the idea was that the body could follow the
same system. However it brought up issues in designing the characters. How much we would be willing to compromise the design in order to achieve the maximum optimization? It was very important the characters had enough individuality from each other to be identifiable in the crowd. Each character needed to be distinguishable so the player could remember/memorize the Customers’ specific cravings or what the Bakers were cooking.

Our solution for the Customers was to use six sets of body parts. Head and arms sets, with one for male and one for female characters of three different skin colors. Legs would come with the clothes, and they would be colored randomly through a script (Figure 4.32). It wasn't the most optimal solution, but it would make the game visually richer. The Bakers would use the same six sets of different heads and arms. However, they had just one option for clothing, a uniform which included a pleated chef’s toque (Figure 4.33).

For the other elements, the main concern was their function on the game. Our idea was that they had to automatically communicate their purpose on the game. So the first
decision was to minimize the amount of elements to just what had a definite function in the
game. Those elements were:

- Stove/Oven – where the recipes are prepared by Bakers
- Counter Top – space for the delivery of the gods
- Cash Register – to provide feedback when an order is concluded
- Baked Goods – game central piece
- Supplies – to inform the volume of supplies remaining

As part of the visual style, we were trying to make the most usage of the modular unit. It was our intention to visually play with shapes and proportions. Design decisions revolved around the best solutions for the characters. It was essential for the characters to stand out against the background, so it was important to guarantee they were the tallest elements on the scene. Therefore, all the other scene elements were to be as big as one modular unit. This would allow us to see the line of costumers forming behind the counter. It would also guarantee that if there were baked goods on top of the counter making the counter and the food two modular units tall, we would still be able to see the costumers behind the counter and the food.

Designing the elements to fit in the cubical shape of the modular unit was very straight forward. For the most part, the elements could be designed as a cube. The most important aspect to consider was that the oven, counter top and supplies elements had to have a flat surface on top – to receive other elements on their flat surface (a baked good on top of the counter as mentioned before, or a stack of supplies). They were designed to be clean and simple, matching the character design.
The Oven was designed to be very neutral, since the player would never directly interact with it. Its design had also to enable the ovens to be placed side by side and still be recognizable, which led to the addition of details on the top and front faces of it (Figure 4.34).

The food counter was designed to emphasize the counter top representing the final step in completing the order. The player would choose where on the counter top to place the baked good. Because of that, the top face was meant to be the main focus, with very definite edges, as to resemble a button and also to separate the areas of interaction when all the counters are together in the game (Figure 4.35).

The supplies were thought to be organized in piles. This stacked configuration provides good visual feedback for how much of the ingredient is left. The color coding was important to communicate each pile was of a different product. So the idea was to get colors which would have a nice contrast among them, and also contribute in adding more interest to the background (Figure 4.36).

The baked goods were meant to contrast the other elements in shape and color. They are the visual result of a player’s decision, and it could mean a reward or a penalty. In the case of a successful order, the player would see the customer taking out the product. If the player chose the wrong recipe, the product would take up counter space and clog the completion of the following orders (Figure 4.37).
The background was first conceptualized to focus on the customers. We thought it could be an advantage for the game to show the bakery façade. This way we would be able to explore the lines of people being formed in front of the bakery shop. However, reevaluating our ideas we realized we were missing the most important part of the game, the kitchen. The idea of the game was to give the players a basic understanding of what takes to be successful in that business, acknowledging some economics issues that we often take for granted as customers. In this sense, we decided to show the bakery from the kitchen’s perspective, focusing on the bakers and emphasizing on all the actions necessary before a customer’s order can be delivered the same perspective one would have if taking care of
such a business in real life. Moreover in this way we also facilitate the game play expanding the usable area and giving it more space to explore different configuration on the kitchen to vary the difficulty level.

Figure 4.38: Final concept with kitchen on the foreground

The surroundings function was basically to refine the player’s game experience. Details like cars passing by, buildings and other urban elements on the surroundings would enrich the game and make it more interesting. We choose to depict a city scene for a couple of reasons. They were to justify the amount of people stopping by a bakery throughout the day, and also to justify the speed the supplies would be delivered after buying them.

4.3 *The Fox and the Grapes*

**Project Description**

*The Fox and the Grapes* is a short animated film, based on the homonymous Aesop’s fable, developed as part of my M.F.A. research at ACCAD. This project was produced over
the period of two years, with the constant advisory of Maria Palazzi and Alan Price, and the cooperation on lighting of ACCAD students Sucheta Bhatawadekar and Joshua Fry.

The main objective of this practice-led research was to further understand the role of the designer in an animated film. More specifically, this experience would bring attention to what are the procedures and knowledge involved in the design process related to this medium.

The methodology employed to this research started with the establishment of the Character Design Process Model – which was based on many sources, ranging from product design literature to articles and books about animation. It continued with the application of this model to the design of the character from “The Fox and The Grapes” film. The process model was experienced and refined at the same time in a constant cycle of discovery of the actual practice; analysis of the context and discoveries; and, intervention on the process based on the lessons learned from the analysis.

Although the area of research interest was Visual Development for animation, the main focus of analysis was the character design process. The animation was based on Aesop’s “The Fox and The Grapes” because, like all Aesop’s fables, its story is driven by the characters’ personalities, actions and behavior. This aspect of the story was interesting to this research because of the potential it offered for the character design to complement and contribute to the story.

*Synopsis*

*The Fox and the Grapes* is a tale about the conflict between what you want and what you can get. It tells the story of how this little fox, who, although failing to find its way to
grapes high up on a vine, manages to overcome its limitations and gets exactly what it wanted.

**Story Treatment / Storyboards**

Figure 4.39: Storyboard panels 01 to 12:

- Open on a medium shot of the woods, establishing the relationship of the grapes with the environment.
- Fox walks in distracted and eating an apple. At sudden stop the fox notices something.
• The smell brings the character's attention to the grapes, what makes the fox drop the apple on the ground with disregard.
• Fox runs back towards the grapes.
• Fox looks up, sees the grapes, and it looks delicious.
• Tries to reach, but it is too high up in the vine.
• It tries to jump, but the grapes are still out of range.

Figure 4.40: Storyboard Panels 13 to 23

• Frustration takes place.
• The character climbs up the tree to get closer to the grapes, but it is still out of reach. That makes the character even more frustrated.

• On a desperate move, the fox jumps from the tree, on a last effort to reach the grapes. But that is not enough either.

• Fox falls on the ground on its back, and looks up.

• The grapes do not look interesting anymore.

• Fox looks to the side and sees the apple on the ground, and now it looks delicious.

• Fox walks away happy, eating the apple.

**Project Setup**

Although *The Fox and the Grapes* Project included the execution of the entire production pipeline, this analysis is focused on the development of the character design process only.

Setting up a project schedule is the first step of any production. And it was not different for this one. However, the nature of this project mutated over time, and because of that, so did its schedule. Because of the important aspects related to all those changes, this topic will be discussed in the Analysis Chapter.

Following through the established model, the character design process needed to start with the story concept before any designing of the character. As mentioned before, story concept tells the designer what the essence of the story is. This keeps the production focused, since all the solutions must be related with the story concept. The process benefitted by the choice of using the Aesop’s fable as base for the plot of this film, since the
story concept was already made in the form of the fable’s moral lesson: “The fox easily despises the grapes because he cannot get them”.

The story concept was enough to start generating basic ideas about the fox’s design. Terms such as confrontation (related to his desire), denial, limitation and resignation start to show some of the complexity that is inherent to the character and that could be translated into the design. So, it is important for this character to be able to perform a wide range of emotions in order for him to communicate the paradoxes or inconsistencies on its behavior/personality.

*Character Description/Briefing*

The character is a young adult fox, without much responsibility, who takes life as it comes. It spends the day wandering through the woods, bored and indifferent, waiting for something to happen. The Fox changes its mind very easily, especially with the only thing that motivates it, food.

The fox appears to be lazy or tired because of its body language. The character is always curved down, which forces the arms to hang and accentuates its salient stomach. The ears, nose and tail, however, are almost a character themselves. Through movement and shape they expand the fox’s state of mind, externalizing and emphasizing the character’s emotions.

*Story Constraints*

This informed what the character is in a broader sense and how it relates to general aspects of the story. Since the story is targeted to a young audience, the character, and the
overall film style, had to be appealing to them. Moreover, the story is actually the result of the character’s personality and choices throughout the film. It emphasizes the need for the character’s broad emotional range to promote all the events which would result from his actions.

**Animation Requirements**

Analyzing both the Character Description and how the story develops into actions, it is possible to establish the Animation Requirements. This set of rules determines what are the design features which allow the character to perform the actions expected from him on the story. Some of the fox’s actions were walking, jumping and falling, all in anthropomorphic postures. Also, the fox would have to be capable of expressing emotions, not only using his face, but also through the body, including especially the nose, ears and tail. Another aspect to take into consideration is the camera movements. There are long and close-up shots, and it will show the character through all angles. That means the character will have to be very detailed and have the entire body topography completed.

Although storyboards were developed in earlier stage of the film production, they represent a great tool to help not only the story and establishment of Animation Requirements, but also to inform the creative process for designing the character. It is the first time the story beats are visualized, which often unveils issues that were not thought before. Moreover, since there were no specific rules for storyboards complexity – other than being efficient in communicating the relationship among camera position, rough scene layout and story beats – it was also a good way to practice and experiment with style and quality of the shapes and movement. One example of that was how the scale relationship
between the arms and legs with the body of the fox represented on the boards generated some ideas and tendencies for the character design.

**Parameters**

All the information gathered during the first stage of the project was then compiled into a set of parameters which would serve as guidelines for the design process. Those parameters were the product of personal interpretation/analysis of how the Story Constraints, Animation Requirements and Character Briefing should inform the character design.

As suggested by the Character Design Process Model, the design was broken down into a set of primary visual aspects (shape, proportions, physical attributes, and color) in order to facilitate its development. Also, using the concept of organizing multi-dimensional and qualitative information presented by Fritz Zwicky into a grid box, it was possible and easier to distinguish how the different categories of information inspired each of the visual aspects of the design (Figure 4.41).

![Matrix system](image)

Figure 4.41: Matrix system
Research

For the fox character the research consisted of three parts. First, I was trying to find out what were the characteristic features of foxes, what identify them as species, what makes them unique and different from other quadruped animals. This part consisted of studying the animal anatomy, habitat, instincts and behavior patterns, alimentary habits, etc. That included reading and the most important, collecting pictures to illustrate all that information.

Another part of the research consisted of exploring how foxes were represented in the past. The most relevant content was related to how it was designed for animated films, since it was the purpose of this character. However, it was also helpful to collect information on how foxes have been represented in other art forms. It was important to find out what were the main aspects picked up during the abstraction process of the character from the real being.

Lastly, there was the research through the Concept art. That served to explore the relationship the fox had with his object of desire in search of inspiration. I questioned myself: What would be the fox’ feelings toward the apple? and towards the grapes? I was aware that the visual treatment at this point did not matter. The importance of the conceptual art, at this stage, was to provoke impressions, feelings. Instead of being attached to the style, or the rendering quality, I was searching how I could generate or translate abstract feelings in a subtle and convincing way (Figure 4.43). The material created served as inspiration and got the process of idea generation started.
Figure 4.42: Concept art

**Ideation**

In this project, the relationship of interdependency of the design elements influenced the methodology applied for the character’s idea generation. The development followed the elements in order, from shapes – more general and broad – to physical attributes – more specific and higher level of detail. As it progressed through more detailed degrees of exploration of the character, each of the design elements served as preliminary studies or starting point for the following one.

I started exploring silhouettes, the most general manifestation of design. Starting with the silhouettes allowed me to abstract the details and focus only on the overall shapes of the body and their relationship. Part of the strategy was to start from primitive shapes: circle, square and triangle. This helped establishing an easy line of comparison and evaluation of the ideas.
There were few things that were supposed to be communicated by the shape of this character. The main aspect of the shape was to support the overall design to achieve a simple silhouette. Another consideration was that the shape, the proportions and the physical attributes had to produce a feeling of flexibility, to relate with the characters wide range of feelings.

Starting from primitive shapes, like a circle, a triangle or a square, they all seemed too stable. However, by varying the body proportions and exploring elongated versions of these primitive shapes, they get less stable and start to give the idea of flexibility. The stretched circle, for example, seems more unstable than flexible. Solutions which included circles stacked did not provide a simple enough silhouette. The stretched triangle with the base makes the character look funky, clumsy and weak; and pointing down, makes him too masculine, or dangerous. Interestingly, the stack of opposite triangles communicates a feminine figure. However, it was the stretched square that provided the character with more desirable characteristics. It provided a very simple silhouette, and the elongated proportion would allow playing with a more curved or sinuous profile (Figure 4.44).
There are also parameters in regards to camera positioning in the scene to be taken into consideration. The fact that there will be long and close-up shots, determines the shape having to be readable in these situations. Moreover, the camera will show the character from all angles, which means that the overall shape has also to be consistent from all angles.
• **Proportions**

Although the body of this character needed to resemble a fox-like body in the end, the proportions were to be stylized and elongated. By having long arms and legs, it would increase the feeling of frustration since we would expect a seemingly tall figure to be able to reach the grapes. I was also looking for bigger ears and longer nose and tail. Since this is a non speaking character they would aid his expression capability.

At this point of the project I made a choice about the style that would influence the rest of the character design and the design of the film as well. My choice was to stay at a stylization level not too far from realistic representation. One reason was because I thought it would be interesting to see what an almost real-like biped fox would look like. Another issue that drove my choice was my intention of creating somewhat realistic shaders. The reflection of this choice was that ideas with extremely long members were discarded. There were a couple of interesting options in which the fox had arms and legs that were twice longer than the body.

The last parameter taken into consideration was how old the fox was. Although it wasn’t specified in the Character Description, as director of the film I allowed myself to imagine the character as an adult fox. Consequently, all the options that had child-like proportions got discarded. The chosen final proportions for the fox were with the whole body six times bigger than the size of the head. The legs and arms were two times bigger than the head, the ears were the same size of the head, such as the nose, and the tail was the size of three heads (Figure 4.45).
• **Physical Attributes**

The detailing for this character was easy. Mostly because the character was a fox and it wouldn’t be wearing any garments. Again, some of the parameters were the same as the ones used for previous design elements; the character needed an exaggerated and flexible nose, tail and ears for the same reason already mentioned. The rest of the body would also need to look flexible for the fox to be able to perform all the action in the story. He will need to jump, raise his arms, climb, fall, and lay down on the floor. In addition, the character also will need fingers to grab an apple.

Throughout the evolution of ideas that came after considering the above mentioned features for the character, a new concept for the character’s physical appearance came up. Interestingly, I started to explore very thin arms and legs just to add a feeling of fragileness, weakness. However, the effect produced was different. The character’s members started to look like unnatural extensions for his body. Making the fox’s arms and legs look like sticks he would be using to reach higher on the vine, was a very interesting metaphor to explore.

One feature that was a challenge was his legs. There were two different options that would drastically change the character. It could either have anthropomorphic legs, which would make more sense since the character was biped, and would, consequently, be easier to achieve more realistic animation. Or, the other option would be accurate to the animal’s anatomy, which would look more consistent with the rest of the character. I decided to follow the parameters and keep the fox-like legs even though it would be harder to animate it.
Deciding how the face was going to look like was also a challenge. The parameters stated that the character was a male fox, which would indirectly influence the design of the face. However, for this attribute, I decided to step beyond the “boundaries” as suggested by Tom Bancroft. I didn’t want it to have any of the character’s behavior associated with its gender. This decision drove me to look for a genderless design. Moreover, there were not any parameters specifying specifically how the face was supposed to look, just that it would need to achieve extreme positions and be emotional expressive. I knew the fox was not going to speak, which would allow me to keep its mouth simple. I also knew the nose and the ears needed to be big, elongated and flexible enough to express the fox’s feelings.
Because of those issues I decided to focus on the character’s eyes and on the area around it. Big eyes, large and well defined eye sockets and brows, and a large forehead provided the character with the necessary capability for a wide range of emotional expressions. In order to make a choice, the ideas were compared based on how much each one explored the eyes, the ears and the nose. The one with the best relationship among these facial elements was picked (Figure 4.46).

![Figure 4.45: Diagram for face evaluation](image)

Lastly, once I had already an idea of what the style was going to be, the detailing would need to follow it. The way the ideas evolved suggested a level of stylization of the forms while still keeping a good amount of details. This aspect influenced my decision in using Maya Fur for the character surfacing. It would help achieving the desirable style for the design with also providing a realistic look. At this point I knew very little about Maya Fur,
but I was aware that it would demand a lot of study and training with this tool in order to achieve the desirable results.

- **Color**

  The parameters were set to make stylized fox-like colors. I was looking for warm tones, varying from orange – being the main identity color – to white in one end and dark brown on another. The darker colors were used to aid the comprehension of the character limits (silhouette), therefore enhancing the limits with the background (addressing figure/ground issues). It was particularly important to emphasize arms, legs and nose, and make them stand out against the background because they were so thin.

  I also considered playing with the tonal values of the colors to emphasize the emotional state of the fox. A possibility for that would be making the colors brighter to show excitement, or dulling it down to show frustration. Another possibility would be making it reddish to communicate the fox’s anger, or cooling it down for showing indifference (Figure 4.47).

![Figure 4.46: Color studies](image-url)
One thing that would affect the color perception was the shading and lighting techniques. I knew that it would need a lot of refinement and adjustments later on in order for the design to achieve the desirable effect in the scene.

**Refinement**

The Refinement stage was the application of the same criteria to contextualized situations in order to consolidate the ideas for the Fox. More than just combining ideas together, it was important to make sure the choices made before would be consistent when deformed by an expression or a pose.

- **Facial Expressions**

  Facial expressions are for testing and consolidating the facial elements, making sure that the elements proposed work in all the needed situations. There were little changes on the ideas for the fox’s design after exploring its facial expressions. One of them was the definition of the design of the fox’s mouth. The shape of the mouth and the jaw had a direct influence on how the head would fit with on the neck. Because of that the extreme options – the too thin and too broad shapes for the mouth – were discarded (Figure 4.48). Although the fox would perform a wide range of emotions throughout the film, the two most prominent feelings were *excitement* and *frustration*. The design was set more neutral to achieve a wider range of emotions. The way it was before, the face was, in its neutral position, with an air of despise. It was limiting some of the expressions.
• **Body Posture**

There were several interesting issues that could be explored concerning body postures. First and foremost, one of them was the balance between an animal and an anthropomorphic figure. The design had two parameters that were conflicting in this sense. One parameter stated that this is a biped character and, the other that it has animal-like movements and mannerisms, and on top of that, the character also had fox-like legs.

Part of my research was dedicated to learning about quadruped animals’ anatomy and movements in order to be able to seamlessly merge all these different qualities in the character. One of the differences between bipeds and quadrupeds is the position of the pelvis in relation to the spine and the legs. The angle formed by the alignment of the spine and the legs in humans is roughly of hundred eighty degrees, and the pelvis follows this alignment to give a natural and comfortable support on the relaxed standing position (Figure 4.49).
In quadrupedism the angle between the spine and the femur tends to be approximately ninety degrees. The pelvis usually aligns with the spine, making it the main element for supporting the weight of the back part of the body. However, the anatomical relative position of spine, pelvis and femur in the fox is different. Thomas and Johnston, in *The Illusion of Life*, explain the differences between the fox and the hound in a study undertaken for Disney’s *The Fox and the Hound* (Figure 4.50).

"Major differences between a fox and a grey hound are immediately apparent when their skeletons are studied. The fox seems crouched, ready to dart, with his legs well under his body and his pelvis tilted down. Most dogs stand more erect than the fox and move with quite a different rhythm."
I tried to reflect these characteristics when deciding on the fox’s biped posture. In its standing position the pelvis is tilted following the femur inclination. Consequently, it affected the spine shape. A straight spine wasn’t matching with the sharp curve on the pelvis aligned with the direction of the legs. The solution was bending the spine to match the curvature of the pelvis. This curvature had also improved the silhouette of the character, providing the character with a lazy and apathetic look (Figure 4.51).
All the other character postures would then be affected by this anatomical issue. For example, the character has two different and opposite ways of raising his arms in the air and jumping to reach the grapes. One, which emphasizes his laziness, his bottom part of the body stays in the relaxed posture, and the spine tilts a little bit to the front and bends back on the top. The other emphasizes his excitement and motivation toward the grapes, in which his legs need to straighten up so his pelvis can rotate and accommodate the spine bending back. This last posture is intended to be exaggerated taking the character design to its limit and emphasizing his attitude toward the grapes (Figure 4.52).
The final design concept resulted from the combination of all those observations (Figure 4.53). The concept was presented in a Character Model Sheet, describing three key orthographic projections that would served as base for the creation of the 3D model.
Implementation: 2D to 3D

Translating ideas from two-dimensional medium to three-dimensional environment is a key step in the process and a challenge for the designer. The exploration of Facial Expressions and Body Postures facilitated the final adjustments in the design and helped establishing the final concept. However, the interpretation of the 2-D final concept into a 3-D model brings up a series of new design problems to be solved. This justifies why, the model suggests the Implementation Stage for character design for computer animation as being associated with part of the Refinement Stage.

- **Modeling**

The Implementation Stage started by designing the character’s orthographic views. They were used as reference for the computer modeling. However, since I wanted to imprint a realistic treatment on the character, it was necessary to plan how fur was going to vary on the character’s body. For that, I developed a Model Sheet to specify how far the fur would be projected orthogonally from the geometry. That gave enough information about how the overall fur length was going to vary along the fox’s body, fitting exactly into the design concept (Figure 4.54).
During modeling, some aspects of the design had to be adjusted because of the added perception of depth. Even with the model matching orthogonally the 2D design, the perspective changed how the shapes were perceived. The snout of the fox, for example, was reduced because it looked always oversized when it was pointing toward the camera. The arms and legs, which were intentionally designed to be thin, had to be thicken to compensate how skinnier than the design they looked in the perspective view.

Other design changes during the modeling stage were more arbitrary. Many solutions that looked good in 2D just did not look right in the 3D model. This was expected since there is a limitation of how complex shapes are represented in two dimensions. The simplification of forms occurs to benefit an efficient communication of the concept. However, often this simplification that is possible in the 2D design implies shapes that are
either physically impossible to be achieved in 3-D, or do not look as good in three dimensions. This happened with the mouth of the fox. The 3D shapes that were created to achieve 2D design lines for the mouth made the rest of the head look strange. These features were redesigned to achieve a balance between what looked good in the 2D concept and what worked on the 3D model (Figure 4.55).

Figure 4.54: 2-D design concept compared with the 3-D model

- Texturing/Surfacing

In parallel with modeling, I was also studying and experimenting with the fur tool of Autodesk Maya. Unfortunately, it is a complex tool with very limited information available, which demanded more time than expected to overcome the learning curve and achieve the intended results. Because of that, the entire project was delayed by approximately one quarter.

In summary, Maya has a multitude of fur attributes (such as length, width, baldness, inclination, roll, tip base roll, scraggle, and clumping) with a value that usually ranges from zero to one. It is the combination of the values for these attributes that allows you to create
an original fur. The problem is that this value is applied throughout the entire mesh. For cases like the fox, the way to control how each fur attribute varies all through the mesh is using an expression or a texture map. Using texture maps, Maya reads the value of the image, in which the black – RGB 0,0,0 – is assigned a value of zero and white – RGB 255,255,255- is assigned a value of one (Figure 4.56). Maya Fur requires that there are no overlapping UVs, and also that they be laid out within the positive quadrant of U and V.

![Image: Value informing fur length](image)

Figure 4.55: Value informing fur length

With a better understanding of how each fur attribute worked, I selected just the ones that would suffice to achieve the desirable character design and fur quality. Once that was established, the fur sculpting process consisted of two steps. First I superimposed a model that simulated the silhouette of the fur on top of the model that had the compensation of fur volume. That helped in providing visual reference for achieving the initial fur design. After the fur was closer to the intended shape the outer model was not
necessary for finer adjustments. The fur sculpting was a very laborious process. It demanded painting maps in Adobe Photoshop for each of the attributes that were controlling the fur look. In Maya, I could evaluate how the changes made on the fur attribute maps were affecting the final look of the fur while also considering the influence of all the other attributes, and then decide if it was necessary return to Photoshop to repeat the process (Figure 4.57 and 4.58).

Figure 4.56: Mesh flattened on 2D coordinate system for texturing and texture map (painted in Photoshop) controlling the fur length attribute
The fur development also included rendering tests with lighting schemes similar to the ones that would be used in the film to determine the character's final color. Since the main light source of the film had a very warm color, it was necessary to adjust the characters color. The light color and the character color added up and came out too saturated in the final render. This problem was solved by slightly desaturating the fox's color.

After the first tests of the character against the background, I decided to make some changes on the fur pattern to improve the overall readability of the character. One of the issues was the intense contrast between the dark color of the ears and the bright color of the head. Against the background, the ears were visually detaching from the body and breaking the unity of the character. The solution was to use a gradient from the color of the head to the dark brown on the tip of the ears. Another issue, similar in nature, was caused by the lack of contrast between the character's snout and nose. Because they were both of very
dark color, it was very hard to read the movements of the nose, such as sniffing. The solution was to change the fur color on the snout to bright colors and increase/create contrast with the dark nose (Figure 4.59).

Figure 4.58: A) old color texture map; B) new color texture map

- **Rigging**

The rigging process also demanded a steep learning curve because of the lack of experience with the task. I started the rig out of a tutorial (http://www.rigging101.com/freestuff.htm) and added to it once I became more confident with the task. Following the parameters, the first rig was built to be as flexible as possible, to enable the fox to achieve exaggerated postures. However, at this stage of the design process, the character had gained a certain level of realism which demanded more realistic movements. Because of that the rig for the body was simplified (Figure 4.60).
The facial rig was kept still very flexible, to enable the fox to be as expressive as possible through the face. The face rig included two layers of interface with the animator: one gesture based, organized by each of the face elements (such as eyelids, eyebrows, forehead, cheeks, mouth, snout and ears); and another control layer for refinement, with access to specific parts of the face topology (Figure 4.61).
• *Animation*

Once the rig was finished, very few design adjustments were made to the character. Animation tests were important to ensure the rig was working and deforming the mesh in the proper way. However, it was again interesting to realize how the combination and manifestation of the choices made throughout the entire design process brought the character to life.

The relationship of shapes and proportions, combined with the way the rig was set up determined in a very specific way how the character was going to perform certain movements. Sometimes these results were impossible to predict, unintentionally adding a lot of personality to the character. It also contributed to the understanding and believability of the character by the viewers.

### 4.4 Analysis

The Applied Studies serve as examples in which the Process Model was analyzed against the steps of the production to better understand the way in which the process pipeline for character design transpires. This analysis separates the applied studies into the stages of the Character Design Process Model, and then summarizes and compares the ways in which the projects relate to the process model and each other.

#### 4.4.1 Preparative Phase

Project Setup is the stage in which the project and its main parameters are established. This stage begins by the designer analyzing the script and/or story and
consequently using this analysis to generate three categories of project parameters: Story Constraints; Animation Requirements; and Character Briefing.

The establishment of parameters for the DripDry project differed from the other applied studies because one of the character’s designs was dependent on the development of procedural effects. The technical demands, in combination with the short timeline, constrained the design choices so much so that the general design solution was defined by the technical constraints.

The formulation of parameters for the Bakery Shop game project differed from DripDry and Fox and the Grapes because it lacked any project constraints at the start of the project. The solution was to extend the Project Setup stage to include a brainstorming session to define the project and establish the constraints.

The categorization of the project constraints into Character description, Story Constraints, and Animation Requirements was similar for the three projects. Character Description was the most important category, providing the most relevant information for the character design in the three projects. In the case of the game project, story did not apply directly, so its Story Constraints category was changed to Project Constraints to define aspects that were informed by the goal of the game. The technical constraints of the procedural effects for the DripDry project, were considered as part of the Animation Requirements category.

Research prepares the designer for the process. In this stage the designer learns about the subject matter, gathers image references, and studies other related projects (precedents).
The Research stage for the Bakery game project worked differently from what is suggested by the model and from how it was performed in the Fox and the Grapes. While the model suggests that Research happens after the parameters are established, the lack of project definition forced the Research stage to move ahead of the Project Setup phase. Because of that, Research gained more importance and was responsible for the definition of the project parameters. In DripDry the duration of the Research stage was reduced due to the fact the overall design of one of the characters had been defined beforehand by the technical constraints.

4.4.1.1 DripDry

Because of aspects of the project, such as short timeframe for project development, a 6-person multidisciplinary team, and technical constraints, the character design process for DripDry was focused on the logistics aspect of the Project Setup. Well defined guidelines for the character design process, good organization of tasks, good communication and cooperation among the team members was essential to the success of the project. Project parameters were established and deeply affected by the needs of the procedural aspects of the project. This demanded an intense coordination between design and technical development and well established parameters allowed us to make quick and accurate decisions. In order to shorten the exploration time, we focused on the development of efficient parameters for the characters. This way, the design and technical effects would be able to evolve simultaneously.
4.4.1.2  *The Bakery Shop - Economics Game*

Because this process was for the design development of a game, it presented a few interesting issues that could be directly related to the character design process for computer animation. In my role in this project, the process focused on Research and Ideation to support the generation of concepts.

The only constraints the project had in the beginning was the goal of creating an educational video-game intended to teach basic economics concepts to second-graders. The any other game design parameters were not defined at the beginning of the project. As a result, the Project Setup phase was extended to include a brainstorming session to determine the nature of the project, as well as to establish the set of objectives which would also serve as parameters for the design.

The Research stage, in this case, also had an important role for the process. In combination with the game objectives, the research and analysis of references helped in expanding and refining the parameters for the design.

One of the main parameters was the functionality aspect of the characters. The design for each element had to support both its function and to imply a method of interaction for playing the game.

4.4.1.3  *The Fox and the Grapes*

The Project Setup phase for *The Fox and the Grapes* emphasized the importance of the relationship between story and character, and how this relationship was manifested in the character design.
In order to draw these relationships, the story was analyzed to find out what were the aspects from the story that had influence on the character design. These were categorized into *Character description*, *Story Constraints*, and *Animation Requirements*.

The next step was to establish how these relationships would be visually manifested within the design. To accomplish that, the character design was broken down into basic visual attributes, such as *Shape*, *Proportions*, *Physical Appearance*, and *Color*, in order to enable the designer more control over how the information from Character Description, Story Constraints, and Animation Requirements would influence the design. This analysis generated a set of parameters for the exploration of each of the basic visual attributes throughout the Ideation process.

4.4.2 Generative Phase – Ideation and Refinement

During the **Ideation** stage, the designer works within the established parameters from the Project Setup stage to generate as many ideas as possible. **Refinement** consists of the process of refining the ideas that were generated during the Ideation stage and narrowing them down to the **final character design concept**.

For the DripDry character design process, the Ideation and Refinement stages were combined. Because of the strong set of constraints, the design was kept at a simpler level so that the refinement could be integrated to the Ideation stage. This approach differed from the other two projects that had looser parameters and more opportunity for exploration.

The simple or reduced design of the water character, because of technical constraints, influenced the overall style of the animation and also informed the design exploration of the Sponge character. Similarly, in the Bakery Shop project, the design
exploration was heavily influenced by the technical constraints that are implied by real-time systems. Moreover, the design exploration required the development of multiple characters and this also informed the style of the game.

However, in contrast to the DripDry Project, in the Bakery Shop there was more time and flexibility within the technical constraints. This allowed for the opportunity to search for a balance between the technical requirements and the design solution.

A common aspect of the design exploration for all the characters in these projects was the simplicity and readability intended for the final design solution. In DripDry, the simplicity and readability determined opposing characters needed to have opposing primitive shapes to quickly communicate their role in the story. In the Bakery Shop, the simplicity supported the creation of a solution that was iconic, improving the readability and perception of the character and its function. In the Fox and the Grapes, simplicity was a way to create a visual unity.

4.4.2.1 DripDry

The short timeframe and technical constraints due to the procedural effects limited the design exploration for water guys, shortening the Ideation stage for their design. In fact, the character concept – the idea that it would be constructed of spheres – was determined by the analysis of the type of effects the team wanted to explore in the film. Since the shape was pre-determined, the ideation of the water characters was limited to exploring different proportions and surface treatments.

The Sponge character had fewer constraints because it did not have any procedural effects associated with the character. Therefore, the design exploration was limited only by short time we had available, which forced the combination of the Ideation and Refinement
stages. The fact that the main character, the Big-Water guy, had a very simple design dictated a path of exploration for the Sponge's design.

_The Bakery Shop - Economics Game_

As the project Concept designer, I was responsible for creating the design concepts for the game, this aspect affected how the process was adapted to cover the process model but only up to the Ideation stage. Another designer was responsible for the refinement of the ideas, and unfortunately this part of the process could not be observed or analyzed.

The Ideation stage for the character and game design was marked by an intensive back and forth between research and experimentation to establish the best relationship of the graphics dimensions, technical constraints and functionality. Because multiple characters would be on the screen at once, and each had to perform a specific function as controlled by the user, there were a number of design implications.

One concern was the optimization of computational resources for achieving maximum performance on interaction. To address this problem, we choose one basic character and created the variations randomly with scripts. The other design problem was in establishing the best relationship between size and amount of characters on the screen for readability. The solution was to design relatively small characters and use iconic representation for increase readability. The garments provide the necessary variation for the characters to be individually recognizable in their roles and in their position within the game play. Their facial expressions functioned as feedback for time elapsed and a player's success rate. So the simplicity and readability were important aspects that had to be considered in the solution.
4.4.2.2  The Fox and the Grapes

The Ideation stage of the fox design process was approached in a very systematic way. The process of idea generation was guided by the parameters established in the Project Setup stage. It followed a line of exploration that went from broader and more general features to the design of the details. This approach was supported by the pre-organization of the parameters in relation to the basic visual attributes of the character design. The generation of ideas started from the exploration of basic shapes and body proportions, and evolved to the exploration of detail with proportions, physical attributes and colors.

I noticed that the Ideation and the Refinement stages were very much related and intertwined to each other. One reason for that may be the fact that there was only one designer for the project, making it harder to discriminate the stages. Or, it may be the way the project was planned and structured.

During the Refinement stage the ideas generated during the Ideation process were combined and refined. The combination as well as the refinement of ideas takes into consideration aspects of the design that relate in the best way to the set of established parameters.

The refinement process was assisted by the technique of contextualizing the design into facial expressions and body posture. These techniques helped defining how certain aspects of the design deform as well as visualizing areas of the design that would not be visible in the relaxed position.

Once all the character design aspects were consolidated and refined, the Final design concept was created in the form of a Character Model Sheet. The model sheet served as
documentation as well as aiding the Implementation process by providing the foundation for the modeling process within the digital 3-D environment.

4.4.3 Generative Phase – **Implementation (2D to 3D)**

The last part of the Refinement stage encompasses the Implementation stage, when the final character design concept is translated to the three-dimensional environment.

Unlike the process model and the DripDry project, the Implementation stage for the Fox and the Grapes demanded more research and 2D ideation. In this case Research and experimentation was necessary to learn about Maya Fur and enable the manipulation of its attributes. There was also a short ideation process to establish the form of the understructure that holds the fur. And later on in the stage, there was a color adjustment that demanded exploration in 2D.

Moving backwards in the process emphasizes that the model should be adapted to meet the project needs during the Project Setup stage. It does not necessarily mean that the process needs another backward step. It means that at a certain stage of the process some critical information was missing, and it is helpful to return to previous stages to acquire the necessary information.

In the DripDry project something similar happened. Despite all the preparation and planning, the implementation stage was also marked by the iteration of Refinement and Research. Design students worked with the CSE students to setup the model in the best way possible to achieve the desirable solutions.
4.4.3.1  *DripDry*

The first step was to refine the scale of the water characters by comparing their sizes. It was easily achieved in the digital environment by scaling up and down the characters. The implementation of the Water guys was not as straightforward as the simplicity of the design concept suggested it would be. There were a lot of back and forth communication and cooperation with CSE students in order to enable the character to perform all the desirable effects seamlessly.

The Sponge character demanded more planning because of the transformation he goes through during the film. The character needed two models, one model for the initial stage and another one for after the transformation is completed.

4.4.3.2  The Fox and the Grapes

The Implementation of the fox character was dependent on the combination of two techniques to achieve the intended shape and look of the design concept. Because of the choice of using fur, the character needed to be “modeled” using the regular polygonal modeling, to establish the underlying structure that would hold the fur and with Maya Fur to control fur length, patterns and dynamics.

Achieving the level of refinement of the shape required a proficiency in Maya Fur software techniques. Therefore, part of the process included the study and experimentation of the tool as well as re-thinking, through drawing, what this under structure might require.

The color of the character had also a major adjustment during this phase. Tests of the character against the background showed that the choices of colors and contrast among the body parts were not contributing with the understanding of the character. One example
of that was the high contrast between the color of the head and the ears was “detaching”
the ears from the rest of the body. The solution was to lower the contrast in that area and
unify the character.
CHAPTER 5

CONCLUSION AND FUTURE WORK

5.1 Conclusion

This practice-led research deepens the understanding of the activity of designing characters for computer animation by establishing a direct relationship between problem-solving processes and generated forms. In order to establish this relationship, existing information from disparate sources was organized into a model based on problem-solving and form generation processes, which became the Character Design Process Model. This model provided framework for two different applications. The model was tested and refined by applying it to the creation of the main character, from “The Fox and the Grapes” animated short film. It was also used as reference for the development of three applied studies of projects developed at ACCAD. The model represents a framework for the development of schemata in the domain of character design, enabling novice designers to engage in the process of building expertise in this activity.

The Character Design Process Model

The Character Design Process Model is a tool for understanding what it takes to design a character for computer animation. It defines both methodical and creative aspects
of the process, by extending the description to the reasoning behind each step. However, it is important to notice that this is not a formula. Rather, it is a planning and organizing model – as the name says – which illustrates how a series of events interrelate seemingly isolated topics to this specific body of knowledge in order to assist the creative process toward an objective (Figure 5.1).

![Diagram](image-url)

Figure 5.0.1: Topics are now organized and interrelated

The context in which this model was developed reflects the importance of the organization of this body of knowledge. I did not have a comprehensive understanding of the whole process before beginning the creation of this model. The constructive approach
for the development of the model was intended to overcome this lack of knowledge. It would support the reflection and self-teaching process while experiencing the character design process. However, it was not until the end of the process that I was able to really evaluate and diagram the process.

One mistake, for example, was the linear interpretation of the process. Considering the complexity of the problems, the process needed to enable more check-points (CP) for evaluation of solutions and more flexibility for restarting a stage, returning to previous stages, as well as advancing to the next one, depending on the evaluation (Figure 5.2). This approach benefits the process by enabling more cycles of ideation and also systematically increases the control over the creation.

These experiences point out the fact the Character Design Process Model should be used as a reference, acknowledging that it always needs to be adapted to the complexity and demands of the project, as it was demonstrated with the Applied Studies analysis.

In general, the model represents a collection of information about:

- the process of establishing design problems
- the elaboration of parameters for the creative process
- the exploration and visualization of ideas
- the refinement of ideas
- the implementation of ideas within the digital 3-D environment
This project also contributes to the development and enrichment of vocabulary related to character design. It adds value to the terminology by exploring their concepts and relating them back to a context. Taking into consideration what Bryan Lawson describes as “concept formation”38 (the development of schemata) this project provides the opportunity for character designers to include in their schema ideas, concepts, and their interrelationships with the creative process.
**Applied Studies**

The process of acquisition of this knowledge, by studying, practicing, communicating, and associating it with different contexts, contributed to the development of schemata. The three applied studies challenge the understanding of all the concepts, and help solidify the elaborate framework.

The analysis of the three applied studies revealed one of the most important aspects of the design process: adaptability. Since each project deals with a different set of problems, it creates the need for the development of specialized approaches to solve specific types of problems. This aspect was emphasized with the utilization of the Character Design Process Model as reference for the analysis. However, it also illuminated the ways in which the basic concepts and their interrelationships with the process were still present.

Ultimately, the applied studies serve as references for designers in regards to the practical application and further understanding of character design. As mentioned previously, although the problems were different, the three projects were dealing with the body of knowledge established by the model. Having the opportunity to analyze different cases, aspiring designers will be able use them as references for future problems/projects.

**5.2 Future Work**

According to Lawson, there are five stages of design expertise. This research explores the first two stages necessary for a designer to become an expert. Next steps for this research would be addressing the last three stages in understanding what makes an expert character designer.
The third stage, the establishment of an identity, or style, of work, is identified as “guiding principles”\textsuperscript{40}, which are developed over time and experience, and represent a key point in the designer’s career. As Lawson points out, after reaching this point a designer can become known and be selected for jobs for this unique set of ideas. It seem that the relationship of cultural background/influence and the pool of precedents developed by the designer, together with the artistic and professional opportunities in which the designer could develop his work, might play an important role in the development of “guiding principles”\textsuperscript{41}. It would be interesting to investigate how designers, that reached this point, define their style and a specific/unique line of work that will differentiate them from other practitioners.

The fourth and fifth stages are the development of the ability to \textit{recognize} situations rather than \textit{analyze} them and the development of design “gambits”, respectively.\textsuperscript{42} Lawson suggests that expert designers use known precedents to link problems to solutions. With experience this skill evolves developing a “repertoire of tricks”\textsuperscript{43} or design gambits that, integrated with the schemata would enable the designer to reach solutions faster and more efficiently. Lawson also demonstrates that cognition plays an important role in creating the “repertoire of tricks”\textsuperscript{44} and sets the background for interesting research in expanding the knowledge about expertise, bringing to light subjective topics such as talent and creative instinct.
LIST OF REFERENCES


ENDNOTES


2 Lawson 443.


4 Lawson 456.


6 Beiman 6.

7 Beiman 7.

8 Beiman 7.


11 Bancroft 17.

12 Bancroft 17.

13 Hedgpeth 103.

14 Hedgpeth 142.

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37 Thomas 183.

38 Lawson 443.

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43 Lawson 454.

44 Lawson 454.