

4 Chapter Four: Digital Graphic Novels

4.1 Introduction

The aim of this study is to formulate a set of guidelines to aid in the development of digital graphic novels that will be used to portray emotional social phenomena using critical systems heuristics and human-computer interaction principles. The researcher believes that it is important to be familiar with the features of a digital graphic novel in order to envision the interface of a digital graphic novel portraying an emotional social phenomenon. Once the features and interface of a digital graphic novel are understood, guidelines for the creation of a digital graphic novel portraying emotional social phenomena using critical systems heuristics and human-computer interaction principles can be developed.

This chapter will discuss the context of the digital graphic novel within the research structure of this study (Section 4.2) and will also provide an overview of digital graphic novels as a whole (Section 4.3). Design rules for digital graphic novels will then be investigated in Section 4.4. Section 4.5 will report on benefits of digital graphic novels and guidelines for creating digital graphic novels will be presented in Section 4.6. Section 4.7 will conclude by offering a summary of the chapter as well as an enriched section of the research structure of this study.

4.2 Context of digital graphic novels within the research structure of this study

As shown in the research structure of this study (Figure 2.2), a literature review of digital graphic novels will take place in the action planning phase of the action research cycle. The action planning and action taking phases of this study will filter into the design science research process in order to create a digital graphic novel. The guidelines for creating digital graphic novels identified in this chapter will be used to inform the creation of the digital graphic novel during the design science research process of this study.

4.3 An overview of digital graphic novels

At the time of writing, the researcher was not able to find a definition of the term digital graphic novel. Therefore, the term graphic novel will be defined in order to extrapolate a definition for the term digital graphic novel. Yang (2008:186) defines graphic novels as 'thick comic books'. Carter (2007:49) further substantiates this by referring to graphic novels as the more refined, older sibling of comic books. Although graphic novels and comic books are two separate entities, they tend to have a shared history. In fact, graphic novels grew out of the comic book movement of the 1960's via writers who sought to make use of the comic book format to address topics of a more 'adult' nature (O'English *et al.*, 2006:173). Callahan (2009:7) claims that the popularity of graphic novels increased after the publishing of Art Spiegelman's *Maus: A Survivor's Tale* (Spiegelman, 1986). *Maus: A Survivor's Tale* was based on the afflictions and survival stories of Spiegelman's father during the Holocaust. After winning a prestigious Pulitzer Prize in 1992, *Maus: A Survivor's Tale* served as a pioneer for other graphic novels such as *Ghost World* (Clowes, 1997), *Fun Home* (Bechdel, 2006), and *Watchmen* (Moore & Gibbons, 1987) as graphic novels began to evolve into a genre entirely of their own. While some graphic novels carried on themes from their comic book predecessors such as superheroes and fantasy, others took it a step further by dealing with issues that include wars, civil rights, history, drugs, sexually transmitted diseases, dealing with disabilities and even family dynamics (Gorman, 2002:42).

The researcher proposes that digital graphic novels can be defined as graphic novels that have been specifically designed for digital media. By bearing this definition in mind, it is easy to note the different requirements for digital graphic novels as opposed to graphic novels. For example, although a digital graphic novel may have the same layout as a graphic novel, the digital graphic novel will require a different colour palette (RGB)¹² as opposed to printed graphic novels (CMYK)¹³ because digital graphic novels are read on a screen and not on printed paper (McGavin *et al.*, 2005:761). Digital graphic novels will also be able to make use of features that graphic novels do not account for, such as sounds. Figure 4.1 provides an excerpt from a graphic novel

¹² RGB – colour is generated by varying the intensity of red, green and blue light on a screen.

¹³ CMYK – colour is generated by varying the amount and combination of ink on paper and is rendered using four colours of ink – cyan, magenta, yellow and black.

while Figure 4.2 provides an example of a digital graphic novel. It is interesting to note how a digital graphic novel can draw the reader's attention to certain aspects or frames by zooming in or changing the camera angle on a page as demonstrated in Figure 4.3.



Figure 4.1: Page excerpt from the graphic novel *Sandkings* (Martin, 1986).



Figure 4.2: Screenshot of a page layout in *The Thrill Electric* (Moore & Reppion, 2015).



Figure 4.3: Each frame of the digital graphic novel page is zoomed into on click (Moore & Reppion, 2015).

By inspecting Figures 4.1, 4.2 and 4.3, the similarities and differences of graphic novels and digital graphic novels become clearer. Therefore, the researcher proposes that although graphic novels and digital graphic novels may closely resemble each other, the design rules of digital graphic novels will differ from the design rules of graphic novels.

4.4 Design rules for digital graphic novels

To date, the researcher is unable to find much literature with regard to design rules for digital graphic novels. Eisner (1990:159) briefly mentions that regardless of the medium in which sequential art is delivered, the fundamental requirements of the art form need to remain the same. The fundamental requirements for sequential art are that the narrative adheres to a general reading convention, the characters are skilfully created, the pages and panels are composed for narrative purposes, and finally, the rendering of the elements (Eisner, 1990:159).

Due to the lack of design rules for creating digital graphic novels, design rules for creating a comic book will be listed and design rules for creating digital graphic novels will be extrapolated from this data. McCloud (1994:170) offers six steps for developing a comic book and maintains that these steps can be applied to any form of art:

1. Idea/Purpose – What are the philosophies, emotions, and purposes of the work? In this step, the creator of the artwork must identify the work's content.
2. Form – What form will the art take? In this step, the creator of the artwork must distinguish how the work will be represented (e.g. digital graphic novel, statue).
3. Idiom – What 'school' will the art belong to? In this phase, the creator of the artwork must identify what genre the work will belong to.
4. Structure – How will everything fit together? In this phase, the creator of the artwork decides what should be included/excluded as well as how to arrange and compose the work.
5. Craft – How will the work be constructed? In this phase, problem-solving, practical knowledge invention, and the application of skills are involved in order to 'get the job done'.

6. Surface – This phase entails the production values and finishing. In this phase, the creator of the artwork adds the final superficial aspects to the artwork.

McCloud (2011:10) also states that regardless of which working method is chosen for the creation of a comic book, there are series of decisions that need to be made. McCloud (2011:10) identifies five categories that can be used to inform and evaluate each decision. These categories are the choices involved with movement, frame, image, word and flow. When the five categories of choices are successfully combined, the author will attain the clarity which enables the reader to comprehend the ultimate goal of the comic book (McCloud, 2011:37). Determining the answers to each of the choice categories does not need to take part in a specific order.

Choice of movement refers to the selection process that a comic book author goes through in order to select which panels of a page to create. When making a choice of movement, comic book authors should enable the reader to ‘read’ the action clearly between frames (McCloud, 2011:12). In order to achieve clarity, it is important that each chosen moment should fit together like a ‘connect-the-dots’ puzzle and represent the correct timing of events (Eisner, 1990:25; McCloud, 2011:14). In other words, if one ‘dot’ (frame) is removed, then the story changes entirely. The choice of movement can be one of six different types (McCloud, 1994:70; McCloud, 2011:15):

- Moment-to-moment – series of moments portrays a single action.
- Action-to-action – series of actions of a single subject (person, object, etc.).
- Subject-to-subject – single scene with changing subjects.
- Scene-to-scene – moments that transition over significant distances of space or time.
- Aspect-to-aspect – moments transition from one aspect of a mood, place or idea to another.
- Non-sequitur – series of seemingly unrelated images and/or words.

Figure 4.4 is a comic book excerpt that displays clarity through the use of a subject-to-subject movement.



Figure 4.4: Page excerpt that illustrates a subject-to-subject movement (Johns & Frank, 2012:10).

The choice of frame relates to the distance with which the author would like to frame an action as well as the level of detail that is needed (McCloud, 2011:19). The entire aim of comics is to relay stories and/or ideas to readers through the medium of pictures and words (Eisner, 1990:38). In order to achieve this goal, comic artists make use of frames to break up events into sequenced segments (Eisner, 1990:38). These frames serve as a reader's guide through time and space (McCloud, 1994:102). Through the use of frames, the reader should be encouraged to focus on important aspects of the story rather than being distracted by trivial views that are irrelevant to the story (McCloud, 2011:20). That being said, it is also not necessary to keep every view at eye level as this may bore the reader (McCloud, 2011:21). A variation of the position, shape and size of a frame can be used to entertain the reader as well as to guide them to the important object or idea (Eisner, 1990:88; McCloud, 2011:24) as demonstrated in Figure 4.5. By altering the shape or presence of a frame, the frame can also be

seen as a part of the narrative itself (Eisner, 1990:46). The frame can be used to contribute to the atmosphere of a page as a whole, convey a dimension of sound or even to provide a visual perspective of the emotional climate within which a certain action occurs (Eisner, 1990:46). The variation of shape or treatment of frames can also generate emotional involvement from the reader (Eisner, 1990:59). In summary, through the manipulation of the frame, the comic artist is granted the ability to guide the reader, clarify actions and stimulate desired emotions (Eisner, 1990:88; McCloud, 1994:99; McCloud, 2011:19).



Figure 4.5: Page excerpt that demonstrates how frames guide the reader's view (Johns & Frank, 2012:13).

The choice of image refers to the creation of pictures that are needed to fill the frames in order for the story to be visually brought to life (Eisner, 1990:89; McCloud, 2011:26). McCloud (2011:26) further states that regardless of the style of art chosen, the fundamental task of the chosen image is to clearly, compellingly and quickly communicate with the reader. McCloud (2011:118) believes that pictures can evoke

an emotional or sensual response as depicted in Figure 4.6. According to Eisner (1990:13), the failure or success of communicating through pictures lies within the ease with which the reader is able to recognise both the meaning and emotional impact of the selected image.

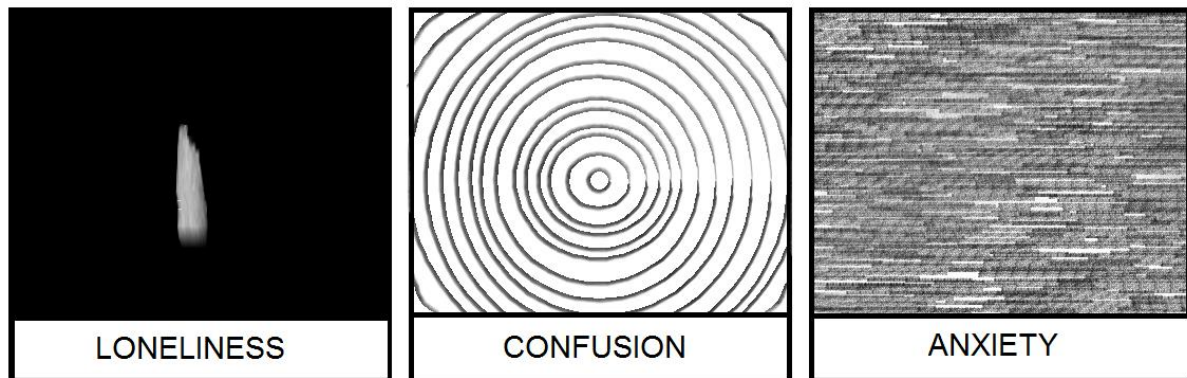


Figure 4.6: Possible use of images to represent or evoke emotion adapted from McCloud (2011:118).

The goal of a writer's choice of words within a comic would be to unambiguously and persuasively communicate the sounds, ideas and voices in a seamless combination with the chosen images (McCloud, 2011:37). This is usually achieved through one of seven distinct categories of word-picture combinations (McCloud, 1994:153; McCloud, 2011:130):

- Word-specific – words describe everything that a reader needs to know while the pictures illustrate the scene described by the words.
- Picture-specific – opposite of word-specific; the pictures provide all the information that the reader needs while the words highlight certain aspects of the scene being shown.
- Duo-specific – the same message is portrayed by both words and pictures.
- Intersecting – both words and pictures make individual contributions to the scene while also working together in certain aspects to create the scene as a whole.
- Interdependent – neither the words nor the pictures would be able to convey the same message/idea on their own.
- Parallel – words and pictures do not seem to support each other or intersect.

- Montage – words and pictures are combined pictorially within a scene.
- The balance between words and images in great comics tends to be dynamic in nature with the images taking precedence in some instances and the words in others (McCloud, 1994:47; McCloud, 2011:128).

The role of the writer is to limit the writing of a comic book in such a way that the reader can still understand the story as a whole by only viewing a compressed version presented frame-by-frame (Eisner, 1990:122; McCloud, 2011:31).

Finally, the choice of flow refers to how to guide a reader through the comic as a whole (McCloud, 2011:32). There is an unwritten agreement with the artist and the reader of a comic which affirms that readers will read frames of a comic from left-to-right first and then top-to-bottom (Eisner, 1990:41; McCloud, 2011:32). This also applies to word balloons and captions within a frame. A comic artist needs to bear this in mind when designing a page so as to identify any aspects in the design that can help or hinder the agreed flow (McCloud, 2011:32).

When writing a comic, it is important for the reader to both care about and understand the story being told (McCloud, 2011:53). In order for a reader to understand the story being told, the comic needs to have clarity which is a result of the correct choices of moment, frame, image, word and flow (McCloud, 2011:53). Getting the reader to care about the story can be achieved in two ways – the content of the story itself or the intensity of the presentation (McCloud, 2011:53). Finding a good balance between both clarity and intensity has reaffirmed philosophical divides within the comic culture with one school of thought being that good stories should be told with much intensity, flair, and ingenious art techniques, while the other believes that the appropriate clarity, events and characters will be effective and encourage a reader to continue reading (McCloud, 2011:52).

McCloud (2011:150) suggests that there are a few goals that an author hoping to write a good story should achieve, these are:

- Stories should be rooted in an author's own experience while also speaking to the experiences of readers.

- There should be novel and attention-grabbing conflicts between characters in the story as well as between individuals and the world around them.
- Readers should be surprised.
- Provoke emotions such as sadness, suspense and joy by exploiting common experiences or heritage.
- Make readers care enough about the story and characters to want to find out more.

A comic author and artist can make the reader care about the characters in the story by designing characters as both believable and vivid human beings (McCloud, 2011:62). Good characters can be measured according to their design, facial expressions and body language. Character design refers to the ability to create a character which is unique and has a distinct personality (McCloud, 2011:62). McCloud (2011:63) states that there are three qualities that a good character should have, namely – an inner life, visual distinction and expressive traits. The inner life of a character contains a character's life history which should help the reader emotionally connect with the character while also providing a platform from which differences in life experiences of the character and other characters can elicit stories worth being told (McCloud, 2011:65). An example of this would be designing a character that grew up in a poor household and has to feed his family by winning a certain boxing match against a very rich competitor who has the best of everything. Visual distinction refers to the character's individual outward design and is important in helping the reader distinguish one character from another (McCloud, 2011:70). In addition, the visual traits of characters will aid in visually reminding readers about their different personalities (McCloud, 2011:71). Expressive traits of a character are essentially the emotional territory of a character and incorporate a character's body language, speech patterns, facial expressions, key expressions, poses and personal quirks (McCloud, 2011:76).

Facial expressions in comics are very important in order for the comic artist to portray the emotions of the characters to the readers as well as to provoke emotions in the readers themselves (McCloud, 2011:81). Eisner (1990:111) states that the face's role in communication is to register emotions and that the face acts as 'an adverb to the gesture or posture of the body'. As Eisner (1990:111) sees it, the face is the surface

upon which the reader expects to reveal an emotion through the variation of its moveable elements. The manner in which readers perceive the context of a facial expression depends on the words with which it is paired. This concept is illustrated in Figure 4.7. As previously discussed, the choice of moment is also vital in determining which facial expression to portray in order to elicit the desired emotions from the reader. Some emotions, such as surprise, may be expressed in a series of images. For emotions such as this, the comic artist can either represent all the emotions in one pane by drawing a face that represents the 'emotional average' of the scene or draw attention to the emotional changes by devoting a series of panels to each change of emotion (McCloud, 2011:99).



Figure 4.7: Example of how words dictate a reader's interpretation of a character's expression adapted from McCloud (2011:94).

McCloud (2011:82) states that there are six basic emotions that every human being exhibits. These emotions are not affected by age, language or culture and the expressions of these can be considered as 'pure' expressions from which a multitude of others are derived (McCloud, 2011:82). The six basic emotional expressions that McCloud (2011:83) mentions are anger, surprise, fear, joy, sadness and disgust. According to McCloud (2011:84), the variation in intensity of each of the six basic emotional expressions as well as their combination leads to the emergence of other emotional expressions all together. For example, if the intensity of the emotional expression for sadness is increased to its maximum, the expression shifts from one of sadness to grief.

Body language and facial expressions work together to represent a certain emotion (Eisner, 1990:111; McCloud, 2011:103). The body language of a character is also a powerful tool for communicating the emotions of a character (Eisner, 1990:113;

McCloud, 2011:103). Readers can tell who a character is or what he is feeling before he speaks just by observing his body language (Eisner, 1990:102; McCloud, 2011:102). For example, an easily frightened character can appear hunched with arms held close to the body while a confident character can be portrayed with chest forward, chin up and hands on hips.

This concludes the discussion of design rules for comic books that may be applied to the design of digital graphic novels. The next section of this chapter will discuss the benefits of graphic novels.

4.5 Benefits of digital graphic novels

The researcher believes that the benefits of graphic novels can be applied to digital graphic novels if one bears the previously discussed definition of digital graphic novels in mind. As a result, we will discuss the benefits of graphic novels as found in the literature and extrapolate them to include digital graphic novels.

Graphic novels can serve as an exciting medium that meets the high need of stimulation that is preferred by generations that grew up surrounded by television and the Internet (Short & Reeves, 2009:417). These individuals are now accustomed to receiving a great deal of both visual and verbal stimulation (Wolf, 1996:124). According to Tabachnick (2007:28), the graphic novel is also well suited to the contemporary age due to its unique and comforting combination of the qualities of both book and screen.

Another benefit of graphic novels lies in the multimedia principle which states that people learn more from words and pictures that are combined rather than from words alone (Mayer, 2008:766), as well as the spatial continuity principle which states that people learn better when corresponding words and pictures are presented near rather than far from each other on the page or screen (Mayer, 2008:764).

Finally, the researcher believes that the use of graphic novels aids in bridging both racial and cultural divides by offering a 'neutral' canvas upon which historical facts can be portrayed. In a democracy as young as South Africa's, the importance of this concept cannot be stressed enough. An example of a graphic novel that deals with a topic of a sensitive social nature is that of *Maus: A Survivor's Tale* (Spiegelman, 1986). In this graphic novel, Art Spiegelman represents different nationalities and races as

different types of animals - for example, Jews are mice, Germans are cats, Poles are pigs, Americans are dogs, etc. By making use of animals instead of social stereotypes, Spiegelman achieves two things. Firstly, he shows the irrationality of classifying human beings based on their ethnicity. Secondly, when reading the graphic novel the reader becomes rather detached from real life. The researcher feels that this may be an important feature when trying to relate a historical event to a younger audience without tainting their perspective of the involved parties.

This concludes the discussion of the benefits of digital graphic novels. Guidelines for creating digital graphic novels will be presented in the section that follows.

4.6 Guidelines for creating digital graphic novels

The researcher has extrapolated proposed guidelines for digital graphic novels that are derived from the literature reviewed in the previous sections and chapters. The guidelines have been categorised according to the fundamental requirements for sequential art as given by Eisner (1990:159). Proposed guidelines for creating digital graphic novels are given in Table 4.1

Table 4.1: Proposed guidelines for creating digital graphic novels portraying emotional social phenomena using critical systems heuristics and HCI principles.

Narrative	
N1	The author should determine the emotions, worldviews and the purpose for developing the narrative (McCloud, 1994:170).
N2	The author should make readers care about the narrative either by the content itself or through the intensity of its presentation (McCloud, 2011:53).
N3	The author should exploit the common experiences or heritage of the target group of the digital graphic novel to provoke emotions such as suspense, sadness and joy (McCloud, 2011:150).
Character	
C1	Characters should engage in novel and attention-grabbing conflicts with themselves, other characters and the world around them (McCloud, 2011:150).
C2	Characters should be designed as believable and vivid human beings (McCloud, 2011:62).
C3	Facial expressions of a character should be used to portray a character's emotions to the reader as well as to elicit emotions from the reader (Eisner, 1990:111; McCloud, 2011:81).
C4	A combination of and variation in the six basic emotional expressions should be used to represent more complex or intense emotions (McCloud, 2011:84).
C5	The body language of the character should be used to communicate the emotions of a character (Eisner, 1990:113; McCloud, 2011:103).
Pages and panels	

P1	Panels that enable the reader to easily follow the narrative should be used (McCloud, 2011:12).
P2	Each panel should lead to and support the next (Eisner, 1990:25; McCloud, 2011:14).
P3	The specific moment that is represented within a panel should serve to elicit emotions from readers or to portray emotion to readers (Eisner, 1990:46).
P4	Movement represented in panels should be one of six different types as given in literature (McCloud, 1994:70; McCloud, 2011:15). Moment-to-moment – series of moments portrays a single action. Action-to-action – series of actions of a single subject (person, object, etc.). Subject-to-subject – single scene with changing subjects. Scene-to-scene – moments that transition over significant distances of space or time. Aspect-to-aspect – moments transition from one aspect of a mood, place or idea to another. Non-sequitur – series of seemingly unrelated images and/or words.
P5	Frames should guide the reader's focus to aspects that are important to the narrative (McCloud, 2011:20).
P6	The variation of the look-and-feel of panels should be manipulated in order to elicit specific emotions from readers (Eisner, 1990:46)
P7	The flow of the digital graphic novel should adhere to the standard that readers will read frames from left-to-right and then top-to-bottom (Eisner, 1990:41; McCloud, 2011:32).
Artwork	
A1	The artist should decide on images that bring the narrative to life for the reader (Eisner, 1990:89; McCloud, 2011:26).
A2	Images should communicate the narrative clearly and compellingly (McCloud, 2011:26).
A3	Pictures should be used to evoke specific emotions or sensual responses from readers in order to increase immersion within the narrative (McCloud, 2011:118).
A4	Images should be combined with narrative text in seven distinct categories as given in McCloud (1994:153) and McCloud (2011:130). Word-specific – words describe everything that a reader needs to know while the pictures illustrate the scene described by the words. Picture-specific – opposite of word-specific; the pictures provide all the information that the reader needs while the words highlight certain aspects of the scene being shown. Duo-specific – the same message is portrayed by both words and pictures. Intersecting – both words and pictures make individual contributions to the scene while also working together in certain aspects to create the scene as a whole. Interdependent – neither the words nor the pictures would be able to convey the same message/idea on their own. Parallel – words and pictures do not seem to support each other or intersect. Montage – words and pictures are combined pictorially within a scene.

This concludes the discussion of digital graphic novels. In the next chapter, we will take a closer look at human-computer interaction in order to further enrich the guidelines for creating a digital graphic novel that portrays emotional social phenomena using critical systems heuristics and HCI principles.

4.7 Conclusion

The researcher will apply the aforementioned rules in the development process of the artwork for the digital graphic novel. It is still necessary to refine guidelines for displaying the artwork of a digital graphic novel as it needs to conform to rules of digital media and not to that of paper-based sources. In order to achieve this, an in-depth look at the human will be taken in the following chapter in order to identify the key factors that need to be considered when creating the design elements of a graphic novel for digital media. Once the study is complete, the researcher will attempt to contribute towards the literature by proposing a set of guidelines for creating digital graphic novels portraying emotional social phenomena using critical systems heuristics and human-computer interaction principles.

5 Chapter Five: Human-Computer Interaction

5.1 Introduction

The goal of this study is to develop guidelines for designing digital graphic novels portraying emotional social phenomena using critical systems heuristics and human-computer interaction principles. It is important to conduct a review of HCI principles and digital graphic novels in order to become familiar with the current literature and offer a valid contribution to the field.

Human-computer interaction (HCI) can be defined as ‘a set of processes, dialogues, and actions through which a human user employs and interacts with a computer’ (Baecker & Buxton, 1987:40). In other words, human-computer interaction focuses on the interaction between human and computers by focusing on the theoretical, psychological and physical aspects of the aforementioned process (Dix *et al.*, 2004:3).

When referring to human-computer interaction, we do not merely refer to a simple desktop computer with a single user. Instead, we consider each of the terms in the following manner (Dix *et al.*, 2004:4):

- Human – any user who is completing a task by means of technology. A human could be either a single user, a group of users who are working together, or users who are required to complete a task in sequence within an organisation.
- Computer – any form of technology ranging from a typical desktop computer to a process system, a large network of computers, or a system that is embedded within other devices (e.g. mobile phones).
- Interaction – any method of communication that occurs between the computer and the user. The interaction may be either direct or indirect. Interaction is considered direct when it involves a dialog between the human and the computer with feedback and control throughout the entire process. Indirect interaction, on the other hand, may involve different methods, such as intelligent sensors that serve to control the environment.

Even though we define each of the terms individually, the most important aspect in terms of human-computer interaction is that the human is interacting with the computer in order to complete a specific task (Dix *et al.*, 2004:4).

This chapter will be divided according to each of the individual terms of human-computer interaction – human, computer and interaction. Section 5.2 will cover HCI in general. Applicable characteristics of humans will be discussed in Section 5.3 which will cover characteristics of humans (Section 5.3.1), the role of the human in HCI (Section 5.3.2), the importance of designing for humans (Section 5.3.3), as well as the process of designing for humans (Section 5.3.4). Applicable characteristics of computers will then be discussed in Section 5.4. Interaction will be covered in Section 5.5 which will include discussions on the interaction framework (Section 5.5.1), interaction styles (Section 5.5.2), why are HCI principles important (Section 5.5.3), what are the HCI principles (Section 5.5.4), and which HCI principles were chosen for this study (Section 5.5.5). Section 5.6 will present a set of guidelines for the design on digital graphic novels portraying emotional social phenomena that has been enriched with the chosen HCI principles for this study and Section 5.7 will conclude by refining the guidelines for creating digital graphic novels portraying emotional social phenomena given in the previous chapter.

5.2 An overview of Human-Computer Interaction

Before exploring each of the individual terms of human-computer interaction (HCI), we need to understand HCI as a whole. The following aspects are important in the field of HCI (Smith-Atakan, 2006:184):

- It provides an overview of an interactive system from the user's perspective.
- It aids in the systematic analysis of the accessibility and usability of existing interactive systems.
- It promotes the design and construction of systems that are useful, usable and accessible.
- It aids in the evaluation of different design options.
- It substantiates the feasibility of creating interactive systems that are easier to use.

Most interactive systems have been developed by software engineers or computer programmers who are familiar with computer systems. This familiarity grants the developers (computer programmers and software engineers) a degree of confidence in using interactive systems that may not be possessed by the public. As a result, the developers of interactive systems often make the mistake of designing an interactive system based on the incorrect assumption that the general public possesses the same level of understanding of computer systems as they do (Smith-Atakan, 2006:7). This yields an inefficient design.

In order for a computer to be used effectively and accepted by its intended users, it needs to be well designed (Preece *et al.*, 1994:5). The term 'well-designed' does not imply that a computer needs to be designed in such a way as to accommodate every prospective user, but rather to be designed to cater for the capabilities and needs of the users for which it was intended (Preece *et al.*, 1994:5). Human-computer interaction serves to unite both theory and practice as it aims to better understand both the designs that users need and the design processes involved in their creation (Smith-Atakan, 2006:2).

There are two major challenges that HCI designers are faced with (Preece *et al.*, 1994:8):

- How to keep up with the rapid changes that occur within the field of technology.
- How to ensure that their designs exhibit good HCI while utilising the functionality of the new technology to its full potential.

There are four main concerns in HCI: the humans, the computers, the tasks that are performed and the support a computer provides a user in achieving a task (usability) (Dix *et al.*, 2004:5). In order for a computer to allow a human to successfully accomplish a task, it needs to satisfy three 'use' words (Dix *et al.*, 2004:5):

- Useful – the user needs to be able to accomplish what is required through the use of the computer (e.g. sending an email).
- Usable – the user needs to accomplish the task easily and in a natural manner (e.g. pressing a 'k' key should produce the letter 'k' and not 'z').

- Used – the computer should be attractive, fun, engaging, etc., and as a result make individuals want to use it.

In order to design a successful computer, designers need to be mindful of the capabilities and limitations of humans and account for these in the design of a human-computer interface. It is also important to bear in mind that designers themselves are not ‘typical users’ (Norman, 2002:155). There is a clear distinction between the forms of expertise needed to be a designer and those of being a user. The core difference between designer and user lies within the fact that while designers often tend to become experts with regard to the device they are designing, users are often experts on/in the specific task that they are trying to accomplish using the device (Norman, 2002:156). While designing the device, designers become so familiar with it that they tend to no longer be able to identify or understand certain features of the device that may lead to difficulty for the users (Norman, 2002:156). Therefore, in order to successfully produce a device that is useful, usable, and used it is important to design for the intended human user.

The literature review of HCI will begin with an examination of the first word of the term human-computer interaction – the human.

5.3 The human in HCI

The role of the human within the human-computer interaction process is to accomplish a specific task through the use of technology (Dix *et al.*, 2004:4). The human can be defined as the individual (user) whom an interactive computer system was designed to assist (Dix *et al.*, 2004:12). As a result of this, the requirements of a user should be considered of highest priority in the construction of a computer system. In order to successfully design a computer system that suits the needs of the intended user, we need to understand their limitations and capabilities (Dix *et al.*, 2004:12). By determining these, we will be able to isolate features that the user may find difficult or impossible to complete (Dix *et al.*, 2004:12).

5.3.1 Characteristics of humans

The capabilities and limitations of the human can be determined by observing the unique features that humans possess. Some of the distinguishing factors that make up humans are (Dix *et al.*, 2004:13):

- Input channels – sight, touch, hearing, smell, taste
- Output channels – eyes, fingers, limbs, vocal system, head, body movement
- Memory – sensory memory, short-term memory, long-term memory
- Problem solving and reasoning
- Emotion
- Differences among individuals

Only sight, hearing, and touch play a big role as input channels of the human-computer interaction process (Dix *et al.*, 2004:14). For example, when attempting to save a file with the same name as an existing file, a user hears a ‘ping’ alert, sees the error dialog box and has to touch the mouse in order to click on the necessary button to continue (see Figure 5.1).

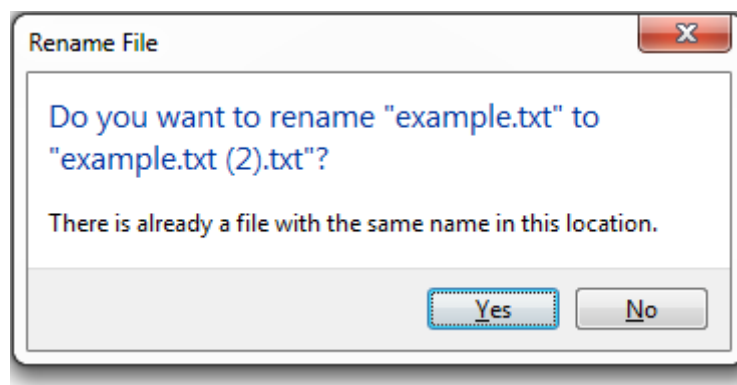


Figure 5.1: Example of error message that incorporates hearing, sight and touch.

For the purpose of this study, we will focus our attention on input channels, memory, emotion (Chapter 6) and differences among individuals as distinguishing factors of humans.

5.3.1.1 Sight as an input channel

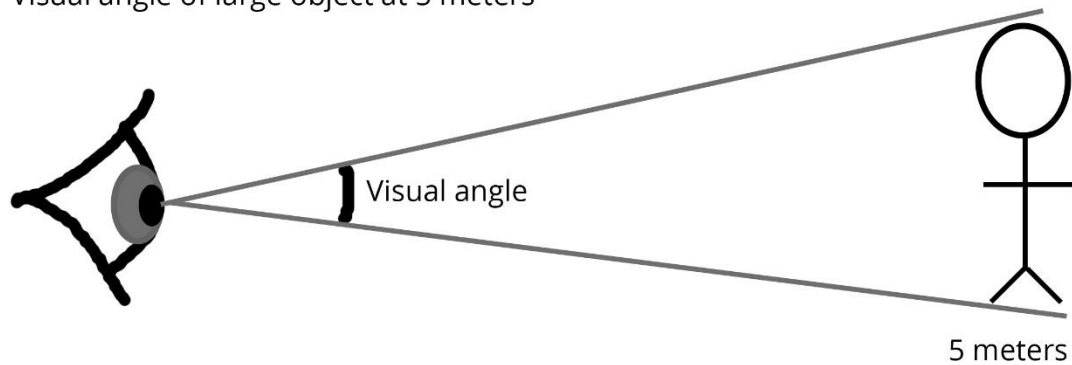
There are numerous theories which claim to explain the manner in which visual perception occurs, however they can be roughly classified into two distinct classes –

constructivist or ecological approaches (Preece *et al.*, 1994:76). Within the constructivist approach, it is believed that our view of the world around us stems from both the information that is contained within our environment and the knowledge that has been previously stored in our memory (Preece *et al.*, 1994:76). On the other hand, the ecological approach claims that perception is merely 'picking up' information in our environment and as a result, does not require any process of construction (Preece *et al.*, 1994:76). For the purpose of this study, we shall adopt the constructivist approach to perception.

Visual perception (sight) is comprised of both the receiving of information through the medium of the eye as well as the processing of the information in order to derive meaning from it (Dix *et al.*, 2004:15). Processing the image received by the eye involves (Dix *et al.*, 2004:16) perceiving size and depth, brightness and colour.

In order to perceive size and depth, the retina of the eye determines the visual angle of an object (Dix *et al.*, 2004:17). Both the size of the object and its distance from the eye affect the visual angle. For example, if two objects of different sizes are at the same distance, then the larger object will have a larger visual angle. This results in the human perceiving the one object as being bigger than the other (See Figure 5.2).

Visual angle of large object at 5 meters



Visual angle of small object at 5 meters

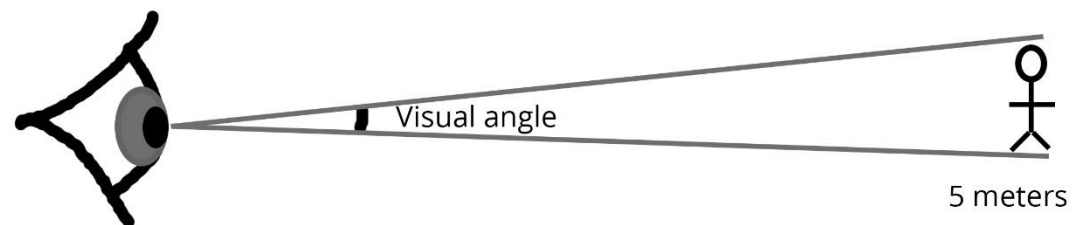


Figure 5.2: Adaptation of graphical representation of the visual angle of two objects of different sizes (Dix *et al.*, 2004:17).

Although an object's visual angle decreases as it moves further away from the eye, the size of the object is perceived as constant (referred to as the law of constancy (Dix *et al.*, 2004:17)). However, if the visual angle of an object is too small, then the human will not be able to detect it (Dix *et al.*, 2004:17). The term used for the ability of a human to perceive fine detail is called visual acuity (Dix *et al.*, 2004:17). The first limitation of the human discussed in this study is the limits of visual acuity. One of the factors that aid perception of size is perception of depth (Dix *et al.*, 2004:17). The human perceives an object to be smaller because it is farther away, not because it shrunk in size. Familiarity with the object's size enables the human to judge the distance of an object (Dix *et al.*, 2004:18).

The perception of brightness in humans is a subjective response to the level of light in their environment (Dix *et al.*, 2004:18). For example, a smartphone screen that is legible in the shade may not be legible in direct sunlight. The brightness of the screen

appears dimmed, but the visual system merely compensated for the extra light. The level of brightness that is perceived is affected by the luminance of an object. The luminance of an object can be defined as the amount of light an object emits subject to the amount of light falling on the surface of the object as well as the reflective properties of the object (Dix *et al.*, 2004:18). Dix *et al.* (2004:18) further state that the visual acuity of the human is increased with luminance. In addition to enhancing the visual acuity of the human, the brightness, size, and depth of an object on a computer screen are some of the factors that aid in the human capability of perceiving a 2-dimensional object as a 3-dimensional object (Preece *et al.*, 1994:83). Colour is comprised of three components (Dix *et al.*, 2004:18) hue (the spectral wavelength of light), intensity (brightness) and saturation (amount of whiteness).

Although the perception of colour, brightness, sight and depth play an important part in the discussion of sight, the perception and processing of text is of particular importance to interface design due to the fact that a form of textual display is often required (Dix *et al.*, 2004:22). The reading process consists of several stages namely (Dix *et al.*, 2004:22):

1. Perception of the pattern of the word on the page.
2. An internal representation of language is used as a reference to decode the perceived word.
3. Language processes including syntactic and semantic analysis are conducted on sentences or phrases.

During the reading process, the human eye makes jerky movements called saccades (Dix *et al.*, 2004:22). These saccades are followed by fixations. Fixation accounts for about 98% of the time spent reading and is the period in which perception occurs (Dix *et al.*, 2004:22). There are also stages in which the eye moves backwards and forwards over the text during the reading process. These are called regressions and tend to occur more as the complexity of the text increases (Dix *et al.*, 2004:22). Research has shown that humans recognise familiar words by the shape of the word (Dix *et al.*, 2004:22). Therefore, if the shapes of words are removed (such as in the capitalisation of text), the speed and accuracy of reading is diminished (Dix *et al.*,

2004:22). Legibility is defined as the speed at which text can be read (Dix *et al.*, 2004:22).

Research done by Muter *et al.* (1982:507) is of particular importance to this study as it shows that reading from digital media was slower than reading from a book. The reason for this decrease in legibility could be as a result of having fewer words to a digital page, the longer line length of a digital page, the orientation of the digital page, as well as the familiarity that the human has with the digital medium (Dix *et al.*, 2004:23). Negative contrast (dark characters of text on a light background) can be used to increase the legibility of text (Dix *et al.*, 2004:23). This is due to the fact that negative contrast provides higher luminance, and as a result, more acuity than a positive contrast (light characters of text on a dark background). Research originally conducted by Bauer and Cavonius (1980:137) as early as the 1980s suggests that, in practice, humans prefer negative contrast displays and that the use of these result in more accurate performance.

The researcher believes that in order to enhance user experience, it is important to understand the dynamics of reading on a digital medium and the basics of human sight when designing a digital graphic novel. The aforementioned topics are summarised in Table 5.1 in Section 5.3.1.6 and will be incorporated within the guidelines for creating digital graphic novels portraying emotional social phenomena as presented in Section 5.6.

5.3.1.2 Hearing as an input channel

Like sight, hearing is important to human performance (Te'eni *et al.*, 2007:75). The human auditory system conveys a large amount of information about an environment (Dix *et al.*, 2004:23). Sound contains a number of characteristics which include frequency and intensity (Te'eni *et al.*, 2007:75). Frequency can be defined as the number of cycles (sound waves) per unit of time while intensity can be defined as the amount of pressure with which a vibration strikes the eardrum (Te'eni *et al.*, 2007:75). Pitch refers to the frequency of a sound – a high frequency has a high pitch and a low frequency has a low pitch (Dix *et al.*, 2004:24). The intensity of a sound is measured in decibels (Db). The range for normal hearing ranges from 20 Db (whisper) to 120 Db (thunder) (Te'eni *et al.*, 2007:75). Dix *et al.* (2004:24) refers to another characteristic

of sound called timbre. Timbre relates to the sound type (Dix *et al.*, 2004:24). For example, a violin and flute may play at the same pitch and intensity, but vary in timbre because they are different instruments.

The human auditory system filters the perceived sounds which enables the human to eliminate any background noise and focus on information that the human deems to be important (Dix *et al.*, 2004:24). This ability is diminished if the frequencies of sounds are too similar or if sounds are too loud (Dix *et al.*, 2004:24).

That concludes the brief discussion of hearing. The researcher believes that incorporating sound into a digital graphic novel will enhance user experience and immersion. As a result, the researcher believes that a basic understanding of human hearing as an input channel is necessary for the design of a digital graphic novel. The aforementioned topics are summarised in Table 5.1 in Section 5.3.1.6 and will be incorporated within the guidelines for creating digital graphic novels portraying emotional social phenomena as presented in Section 5.6.

5.3.1.3 Touch as an input channel

Touch is often viewed as being less important than sight and hearing, but it is vital for providing important information from the environment (Dix *et al.*, 2004:25). For example, if humans could not detect heat, cold and pain via touch they would be subject to grave harm as they would not be able to sense when a part of their body was being hurt. Similarly, if touch did provide feedback when attempting to lift an object, humans would not know how much force to exert to accomplish the task. Thus, the absence or reduction of the sense of touch results in a reduction of the speed and accuracy on an action (Dix *et al.*, 2004:25). As a result, touch serves as an important means of feedback, and this is also true within the context of human-computer interaction (Dix *et al.*, 2004:25). For example, an important part of pressing a mouse button is being able to feel the button depress.

Unlike vision and hearing, the touch receptors are not localised in the human body (Dix *et al.*, 2004:25). Humans receive touch stimuli through three types of sensory receptors found in the skin (Dix *et al.*, 2004:25) namely – thermoreceptors (respond to heat and cold, nociceptors (respond to intense pressure, heat and pain) and mechanoreceptors (respond to pressure).

An aspect that falls within the perception of touch is kinesthesia. Kinesthesia refers to the brain's awareness of the limbs and body (Dix *et al.*, 2004:26). Three types of receptors in the joints are responsible for kinesthesia (Dix *et al.*, 2004:26) namely – rapidly adapting receptors (movement of a limb in a particular direction), slowly adapting receptors (movement and static position) and positional receptors (only when a limb is in a static position).

It is important to understand that kinesthesia affects both the performance and comfort of a human (Dix *et al.*, 2004:26). For example, for an individual who is a touch typist, both the feedback from the keyboard and the awareness of the fingers in relation to the keys are of utmost importance. The researcher believes that it is important to consider the sense of touch in the design of a digital graphic novel. While the digital graphic novel is not a hardware component, and may be played on a variety of devices, adding features such as button highlights when the user touches a button may help users to consolidate kinesthesia without any physical feedback.

This concludes our discussion on input channels. The researcher believes that it is important to consider the sense of touch in the design of a digital graphic novel. While the digital graphic novel is not a hardware component, and may be played on a variety of devices, adding features such as button highlights when the user touches a button may help users to consolidate kinesthesia without any physical feedback. The aforementioned topics are summarised in Table 5.1 in Section 5.3.1.6 and will be incorporated within the guidelines for creating digital graphic novels portraying emotional social phenomena as presented in Section 5.6. We will now discuss the remaining characteristics of humans identified in Section 5.3.1.

5.3.1.4 Memory as a human characteristic

There are three different types of memory, namely – sensory, short-term and long-term (Lutz & Huitt, 2003:1; Dix *et al.*, 2004:28). Sensory memories are memories that are associated with the senses (Lutz & Huitt, 2003:3). There is a type of sensory memory for each sensory stimuli – haptic memory (touch), iconic memory (visual) and echoic memory (aural) (Dix *et al.*, 2004:28). If sensory memory is not transferred to a more permanent memory store, it will rapidly decay and be overwritten. Sensory memories are continually overwritten by new information that is received through the

aforementioned senses (Dix *et al.*, 2004:28). This process occurs within three seconds for aural stimuli and half a second for visual stimuli (Lutz & Huitt, 2003:3). Attention is used to pass information from sensory memory to short-term memory (Dix *et al.*, 2004:29). Attention can be defined as the focusing on a specific stimulus while making a conscious effort to ignore others that are not of interest at that specific moment (Lutz & Huitt, 2003:3; Dix *et al.*, 2004:29). Attention can be influenced by the complexity of new information, the similarity between the competing stimuli or ideas, the meaningfulness that the learner associates with the new stimulus, and finally the physical ability that the individual has to attend (Lutz & Huitt, 2003:3).

Short-term memory is used to store transient information (Dix *et al.*, 2004:29). As a result, it has a very limited capacity and information will be lost if no action is taken on it within 15-30 seconds (Lutz & Huitt, 2003:4). One method for measuring capacity allows individuals to recall items in any order. The second method for measuring capacity is the determination of the length of a sequence that can be recalled in the correct order (Dix *et al.*, 2004:29). According to research conducted by Miller (1994:343), the average individual can recall 7 ± 2 digits. A generalisation of this principle is that individuals can store 7 ± 2 chunks of information in short-term memory. As a result, chunking information may increase short-term memory (Dix *et al.*, 2004:30).

Long-term memory serves as the storage area of all knowledge, perceptions, and information learned by an individual (Lutz & Huitt, 2003:5). Long-term memory differs from the aforementioned memory types in various ways. Unlike sensory and short-term memory, long-term memory tends to have a vast, if not unlimited, capacity. The access time for long-term memory is also longer than sensory and short-term memory at approximately a tenth of a second. And finally, it takes longer for an individual to forget something that is stored in long-term memory, if even at all (Dix *et al.*, 2004:32). Long-term memory can be categorised into two types, namely – semantic memory and episodic memory (Tulving, 1972:384; Dix *et al.*, 2004:32). Semantic memory serves as a structured record of concepts, facts and skills that an individual has acquired while episodic memory stores information about events that took place in an individual's life (Tulving, 1972:386; Dix *et al.*, 2004:32). Information contained in

semantic memory is derived from episodic memory in order for an individual to acquire new concepts or facts from events and experiences (Dix *et al.*, 2004:32).

According to Lutz and Huitt (2003:6), in order to facilitate learning, information must be presented in a manner that lends itself to being incorporated into the memory structure of an individual. Sprenger (1999:75) states that emotions can activate many storage areas and that emotional memory strategies are the most powerful. LeDoux (1996:287) further stated that the brain releases specific neurotransmitters that aid in memory retention when it experiences both negative and positive emotions and that strong feelings about content can enhance emotional memory (Sprenger, 1999:76). Sound, role-playing and the plot or conflict of a story can be used to elicit strong feelings from the target audience (Sprenger, 1999:76). Memory can also be obtained by the way in which semantic information is presented. Storytelling is an exciting way for accessing multiple memory lanes in an individual (Sprenger, 1999:76).

The researcher believes that an understanding of human memory is essential for the design of a digital graphic novel portraying emotional social phenomena. This is due to the fact that digital graphic novels of this nature will often aim to teach their target audience about an emotional social phenomenon and a basic understanding of human memory will aid in achieving this. The aforementioned topics are summarised in Table 5.1 in Section 5.3.1.6 and will be incorporated within the guidelines for creating digital graphic novels portraying emotional social phenomena as presented in Section 5.6.

5.3.1.5 Differences among individuals

Although humans share many capabilities and limitations, not all humans are the same (Dix *et al.*, 2004:52). Some individuals may prefer a slightly ‘busy’ page, while others may prefer a ‘clean’ looking page. Some individuals may be indifferent to a certain aspect of an interface under certain circumstances, and may be frustrated by it in other circumstances. For example, a certain user is usually indifferent to the fact that closing an internet browser closes all the tabs within the browser. However, if the same individual spent a considerable amount of time finding specific web pages and closed the internet browser by mistake, the user may feel frustrated at the fact that closing the browser closes all the tabs within the browser. It is important to be aware of the differences of individuals in order to be able to account for them within the design of a

human-computer interface (Dix *et al.*, 2004:52). It is also important to distinguish between long-term differences (e.g. culture, gender, intellect, physical abilities) and short-term differences (e.g. fatigue, stress). Both types of differences should be considered when designing a human-computer interface.

That concludes the brief discussion of the differences among individuals and the discussion of characteristics of humans. The researcher believes that it is important to understand and cater for differences among individuals in order to create a digital graphic novel that successfully caters to its target audience. The aforementioned topics are summarised in the next section.

5.3.1.6 Influence of human characteristics on the design of a digital graphic novel

Table 5.1 summarises the characteristics of humans discussed in this chapter and their influence on the design of a digital graphic novel. These concepts will be incorporated within the guidelines for creating digital graphic novels portraying emotional social phenomena as presented in Section 5.6.

Table 5.1: Important concepts of the human and their impact on the design of a digital graphic novel.

Concept	Application to this study
Sight	
Familiarity – the distance of an object can be judged if the human expects the object to be of a particular size (Dix <i>et al.</i> , 2004:18).	By making use of the familiarity principle, the researcher will be able to simulate depth of field within the digital graphic novel.
Visual acuity – the ability of a human to perceive fine detail (Dix <i>et al.</i> , 2004:17).	The thickness of lines and spaces between lines in the digital graphic novel should not fall outside an individual's ability to perceive it. Luminance increases an individual's visual acuity.
Brightness, size and depth of an object on a computer screen aid in an individual's ability to perceive a 2-dimensional object as a 3-dimensional object. (Preece <i>et al.</i> , 1994:83).	By varying the brightness, size and depth of images within the digital graphic novel, the researcher will be able to project a 2-dimensional image as a 3-dimensional image within the digital graphic novel.

If the shapes of words are removed (such as in the capitalisation of text), the speed and accuracy of reading is diminished (Dix <i>et al.</i> , 2004:22)	The text in the digital graphic novel should not be written in capital letters in order to promote legibility and accuracy in reading.
Negative contrast (dark characters of text on a light background) can be used to increase the legibility of text (Dix <i>et al.</i> , 2004:23).	The text of the digital graphic novel should be black on a white background in order to promote legibility.
Hearing	
The range for normal hearing ranges from 20 Db (whisper) to 120 Db (thunder) (Te'eni <i>et al.</i> , 2007:75).	The designer of a digital graphic novel should ensure that the sounds used within the novel fall between the appropriate intensity and frequencies while not being too similar or too loud.
The human ear is capable of hearing sounds with frequencies between 20 and 20 000 hertz (Hz) (Te'eni <i>et al.</i> , 2007:75).	
Humans tend to respond to frequencies between 1000 and 10 000 Hz (Te'eni <i>et al.</i> , 2007:75).	
This ability of a human to focus on important information is diminished if the frequencies of sounds are too similar or if sounds are too loud (Dix <i>et al.</i> , 2004:24)	
Touch	
It is important to understand that kinesthesia affects both the performance and comfort of a human (Dix <i>et al.</i> , 2004:26).	Features such as button highlights and page turning animations may help users to consolidate kinesthesia without any physical feedback that may affect the performance and comfort of a user.
Memory	
Attention can be influenced by the complexity of new information, the similarity between the competing stimuli or ideas, the meaningfulness that the learner associates with the new stimulus, and finally the physical ability that the individual has to attend (Lutz & Huitt, 2003:3).	Content presented in the digital graphic novel should not be complex. The content of the digital graphic novel should elicit a sense of meaningfulness from the reader.
Chunking information may increase short-term memory (Dix <i>et al.</i> , 2004:30).	The narrative text should be presented as concise sentences and not paragraphs.

According to Lutz and Huitt (2003:6), in order to facilitate learning, information must be presented in a manner that lends itself to being incorporated into the memory structure of an individual. Sprenger (1999:75) states that emotions can activate many storage areas and that emotional memory strategies are the most powerful. Sound, role-playing and the plot or conflict of a story can be used to elicit strong feelings from the target audience (Sprenger, 1999:76). Memory can also be obtained by the way in which semantic information is presented; storytelling is an exciting way for accessing multiple memory lanes in an individual (Sprenger, 1999:76).	The digital graphic novel should make use of sound and a well-written narrative in order to elicit emotions and activate emotional memory in readers.
Differences among individuals	
Although humans share many capabilities and limitations, not all humans are the same (Dix <i>et al.</i>, 2004:52).	Research of the target audience of the digital graphic novel needs to be conducted in order for it to cater to their specific requirements, preferences, etc.
It is important to be aware of the differences of individuals in order to be able to account for them within the design of a human-computer interface (Dix <i>et al.</i>, 2004:52).	
It is also important to distinguish between long-term differences (e.g. culture, gender, intellect, physical abilities) and short-term differences (e.g. fatigue, stress).	

This concludes the discussion of the characteristics of humans in human-computer interaction. Design principles for humans within the human-computer interaction process will be discussed in the following section.

5.3.2 Design principles for humans

According to Norman (2002:188), in order to design according to the needs and interests of human users, a designer should:

- Bear human constraints in mind in order to make it easy for the user to determine what actions are possible at any point.
- Make items visible, such as alternative actions and the results of actions taken.
- Enable the user to determine the current state of the system.

- Ensure that the mapping between a user's intentions, actions and the resulting effects occurs in a natural manner. A natural mapping should also exist between information that is shown and the current state of the system.

The aforementioned can be simplified into two main concepts (Norman, 2002:188):

- The user needs to be able to determine what to do.
- The user needs to be able to tell what is going on.

Norman (2002:188) states that in order to design for humans, designers are required to:

- Make use of knowledge present within the user's world, and determine the knowledge the user possesses.
- Ensure that the structures of tasks are simplified.
- Ensure that items are visible to the user.
- Ensure that all mappings between the user and the device are correct.
- Exploit the power of natural and artificial constraints by incorporating them into the design.
- Design with the anticipation of error.
- Standardise in order to increase a user's familiarity with a device.

A human-computer interface designer can apply the aforementioned by familiarising himself with the types of constraints that can be applied to a human-computer interface with regard to human users.

5.3.2.1 Summary of constraints

From our previous discussions of important factors of humans, we can derive four main groups of constraints that should be incorporated in the design of the human-computer interface (Norman, 2002:84). These four groups of constraints are:

- Physical constraints
- Semantic constraints
- Cultural constraints
- Logical constraints

Physical constraints can be used to limit the possible operations of a user (Norman, 2002:84). An example of a physical constraint is the fingerprint scanner present in

some laptops. The size of the fingerprint scanner indicates that only one finger can be scanned at a time. As demonstrated in this case, the efficiency and usefulness of a physical constraint is increased by its ability to be seen and interpreted, because the set of possible actions has been restricted before any wrong action can be attempted (Norman, 2002:84). In other cases, a physical constraint can prevent an incorrect action once the action has been attempted – for example, trying to play a DVD in a CD drive.

Semantic constraints are dependent on a human's perceived meaning of a situation in order to control the set of possible actions (Norman, 2002:85). Semantic constraints also rely upon a human's knowledge of a situation and the world (Norman, 2002:85). For example, when a computer seems to be 'frozen' the correct interpretation of the situation by the user will determine the actions that can be taken. If a user thinks that there is nothing wrong with the computer, or that it is just taking a little longer to open a new window than usual, the user might wait and see when the computer reacts. On the other hand, if the user perceives the time taken to open a new window to be too long, the user might try to move the mouse to determine if the computer is 'frozen' or not. If the pointer on the screen does not react to the movement of the mouse, the user may try to reboot the computer.

Cultural constraints rely on culturally accepted conventions (Norman, 2002:85). For example, some women within the religion of Islam choose to cover their faces in public. This constraint does not allow them to make use of facial recognition software in public places and therefore the designers of a login system that uses facial recognition should also incorporate a 'backup password' in order to accommodate these constraints.

Natural mappings are made possible due to logical constraints (Norman, 2002:86). Logical constraints are reflected by the relationships between the functional and spatial layout of components and that which they affect or are affected by (Norman, 2002:86). For example, pressing the 'a' key on the keyboard of a computer yields the letter 'a'.

A human-computer interface designer can bear the aforementioned constraints in mind and provide affordances to help the user interpret what to do.

5.3.2.2 Affordances

Affordances can be defined as both the perceived and actual properties that an item possesses, and more specifically, the properties of an item that determines its use (Norman, 2002:9). Affordances provide convincing clues regarding the use of an object (Norman, 2002:9). For example, when a user receives a dialog box with an 'Ok' button at the end, the user is aware that the button should be pressed once the content has been read and understood. This affordance can be improved by disabling all the background windows and highlighting the dialog box or 'Ok' button whenever the user tries to click elsewhere. Within the scope of a digital graphic novel, the page can zoom back out to full size once all the frames on the page have been read. This indicates that the page is complete and that the user can move onto the next page.

The researcher believes that a successful digital graphic novel can be created by understanding the nature of a human, the human's role within the human-computer interaction process and how to design with the human in mind. This concludes the discussion of the human within the human-computer interaction process. We will now discuss the second word of the term human-computer interaction – the computer.

5.4 Computer in HCI

In order to fully understand the human-computer interaction process, it is important to understand both of the parties that are involved within the interaction process – the human and the computer (Dix *et al.*, 2004:60). Having discussed the human in the previous section, we will now direct our attention to the computer. In this section, we will cover the various input-output devices and discuss the manner in which technology influences the interaction and subsequently, the styles of human-computer interfaces. We will begin this section by defining a computer.

A traditional computer is a machine that is composed of input devices, output devices, memory, processors and communication channels (Dix *et al.*, 2004:61). Examples of the five different types of hardware that make up a traditional computer are (Dix *et al.*, 2004:61):

- Input devices – Keyboard, mouse, touchscreen, touchpad, motion tracker
- Output devices – Screen, speaker, printer

- Memory – Random-Access Memory (RAM), short-term memory, hard disk
- Processors – Central processing unit (CPU), graphics processing unit (GPU)
- Communication channels – Internal communication (facilitated by the motherboard), external communication channels (e.g. Local-Area Network (LAN), Wide-Area Network (WAN))

The term 'computer' can also refer to any kind of technology ranging from the traditional personal computer to an extensive computer system and can even be extended to include an embedded system or process control system (Dix *et al.*, 2004:4). Although digital graphic novels are read, they also serve as an interface as the human interacts with the computer through the interface of the digital graphic novel. For example, in order to turn a page in the digital graphic novel, the human must click on certain areas of the digital graphic novel itself. Therefore, for this study, the researcher has extended the aforementioned definition to include digital graphic novels as the computer component with which users will interact. We will now discuss the third word of the term human-computer interaction – the interaction.

5.5 Interaction in HCI

We can define interaction as the communication that occurs between the human and the computer. Interaction can also be viewed as the process of information transfer between the human and the user and vice versa (Dix *et al.*, 2004:60). In general, the purpose of an interactive system is to aid a user in his intention to accomplish a specific goal within a certain domain (Dix *et al.*, 2004:125). This definition can be better understood by defining the key terms from which it is comprised (Dix *et al.*, 2004:125):

- Intention – A particular action that is essential in achieving a goal.
- Goal – The desired output as a result of performing a task.
- Task – Operations that can be conducted in order to influence the concepts within a domain.
- Domain – A specific area of expertise and the knowledge contained within a certain real-world activity.

Norman (2002:48) developed a model of interaction between the human user and the computer where the user devises an action plan that is executed at the computer's interface. Once the plan or a section of the plan has been executed, the user evaluates

the outcome of the executed action plan and determines further steps to be taken by observing the computer interface (Dix *et al.*, 2004:125). Norman (2002:49) identifies two major phases into which the model of interaction can be divided – the execution phase and the evaluation phase. There are various states within human-computer interaction that result in the separation of mental states and physical actions – some of these occur within the execution and evaluation phases and are referred to as the Gulf of Execution and the Gulf of Evaluation respectively (Norman, 2002:50). The Gulf of Execution can be identified as the difference between the intentions of the user and the actions that are allowable within the computer system (Norman, 2002:51). Norman (2002:51) suggests that one measure of the Gulf of Execution is the degree to which a computer system allows a user to directly perform the intended actions, without extra effort. Therefore, a good question to ask when evaluating the Gulf of Execution would be (Norman, 2002:51): Does the system provide actions that are equivalent to those that the user wishes to perform? The Gulf of Evaluation can be identified as a reflection of the amount of effort exerted by a user in order to interpret the physical state that the system is in, as well as to determine the degree to which the expectations and intentions of the user has been met (Norman, 2002:51). The Gulf of Evaluation is deemed to be small when the computer system provides the user with information about its state in a manner that is easy to acquire and interpret and also correlates with the manner in which the user views the system (Norman, 2002:51).

There are three core actions that serve to bridge the gap between what a user would like to do and all the possible physical actions available on the computer system and consequently bridge the Gulf of Execution. Once a goal is established, a user can form an intention to attain the goal, identify what actions need to be taken and then perform them – this is the stage of execution (Norman, 2002:48). Three core actions aid in bridging the Gulf of Evaluation. The user perceives what happens in the world, interprets the event, and compares it to his original intentions (Norman, 2002:48). The aforementioned actions can be summarised into seven stages of action (Norman, 2002:48):

1. A goal must be formed.
2. An intention must be formed to achieve the goal.
3. An action to achieve the goal must be specified.
4. The specified action must be executed.

5. The current state of the world must be perceived.
6. The perceived state of the world must be interpreted.
7. The outcome must be evaluated to see whether it compares to the user's original intentions.

Although Norman's model allows more complex work to be placed within the bounds of a common framework, it concentrates only on the interaction from the user's point of view. It does not discuss the communication that a system conducts through the interface (Dix *et al.*, 2004:127). Abowd and Beale (1991:73) adapted Norman's model in order to develop the interaction framework, which serves to offer a more realistic description of what happens during the interaction between the human and the computer.

5.5.1 Interaction framework

Abowd and Beale (1991:73) offer a more realistic description of the interaction process by breaking it down into four components, namely – system, user, input and output. According to Abowd and Beale (1991:74), the system and the user each have their own language in which they express their concepts and operations. The system's language is referred to as the core language, while the user's language is referred to as the task language (Abowd & Beale, 1991:74). In addition to these languages, the input and the output components possess languages of their own that represent the separate components although they may overlap (Abowd & Beale, 1991:75). The combination of the input and output form the system interface (Abowd & Beale, 1991:75). Abowd and Beale (1991:75) distinguish between two types of interfaces:

- System interface – composed of the input and output components.
- Physical interface – part of the interface that is in direct contact with the human user.

Each type of interface forms a subset of the interface used within Abowd and Beale's (1991:75) framework shown in Figure 5.3.

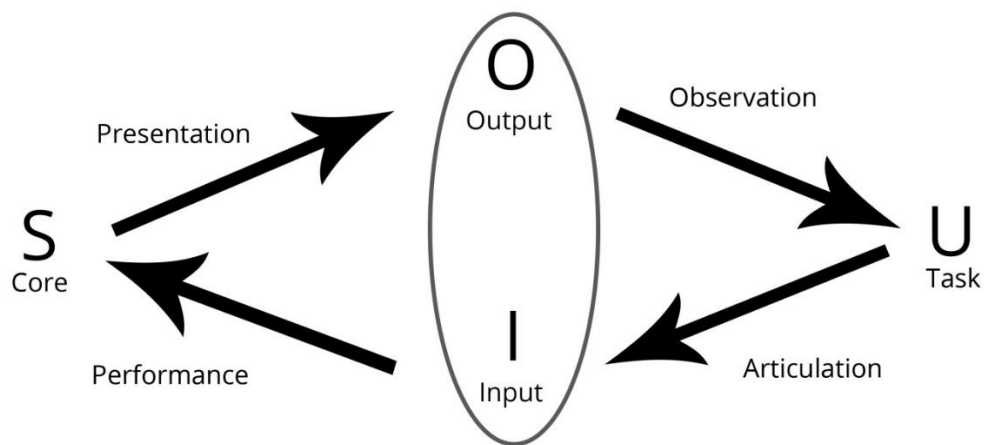


Figure 5.3: Translations between components (Abowd & Beale, 1991:76).

Abowd and Beale's (1991:76) framework closely resembles that of Norman (2002:48) in that the interactive cycle begins with the user formulating a goal and the action required to achieve that goal. Due to the fact that the user is only able to manipulate the computer through the input, the task must be articulated from task language into input language. The input language is further converted into core language, as the input needs to communicate with the system. Once the system transforms itself as required by the user, the execution phase is complete. The evaluation phase begins with the system's new state being transformed from core language into output language. The user is then able to view the output and compare the new system state to the original goal. Once this is done, the evaluation phase is completed – along with the interactive cycle (Abowd & Beale, 1991:76).

This concludes the discussion of the interaction framework. Methods of interaction will be discussed in the following section.

5.5.2 Interaction styles

As previously defined, interaction is the communication between the user and the computer. There is a wide range of interface styles that can be applied to this dialog (Dix *et al.*, 2004:136). Each style possesses its own effect on the interaction process. Table 5.2 lists the common interface styles and their key attributes (Dix *et al.*, 2004:136):

Table 5.2: Common interface styles and their key attributes (Dix et al., 2004:136).

Interface Type	Attributes
Command line interface	Powerful. Flexible. Allows users direct access to system functionality. Difficult to use and learn.
Menus	Options are visible. Options are meaningfully and logically arranged in groups.
Natural language	Users need not remember a command or get lost in menus. Ambiguity of language results in difficulty in comprehension for the computer.
Question/answer	Simple mechanism to obtain user input. Limited in functionality and power.
Query dialog	Uses natural-language-style phrases. Requires a specific syntax. Requires knowledge of a database structure. May become complex when more than one attribute is queried.
Form-fills	Useful for data entry/retrieval. Easy to learn and use.
Spreadsheets	Values can be freely manipulated. Blurred distinction between input and output. Flexible. Natural.
WIMP (Windows Icons, Menus, Pointers)	Familiar. The WIMP interface can be deemed familiar due to the fact that users of desktop computers, laptops, tablets and even smartphones use operating systems that incorporate the WIMP interface style of windows, icons, menus and pointers.
Point and click	Virtually all actions can be performed by a single click of a mouse button. Not limited to mouse-based interfaces (e.g. touchscreens).
Three-dimensional interfaces	Allows users to actively participate in a virtual world rather than being a spectator. Sculptural effects may not be properly applied, which results in a loss of differentiation.

Due to the fact that point and click interface systems are employed in most web pages (Dix *et al.*, 2004:142), the point and click interface style will be applied to this study as the digital graphic novel will be hosted on a web page. The point and click interface style will enable the digital graphic novel to be played on devices that do not contain keyboards and mice. The digital graphic novel will be used within a WIMP interface and will therefore have to comply with the WIMP interface style. Finally, because the digital graphic novel will be made available to a wide audience, the researcher feels that the interface style used should be familiar and not be hard to learn or use.

Certain principles should be used in order to create an interface that is useful, usable, and used. Several sets of human-computer interaction principles will be discussed in the following section.

5.5.3 The use of HCI principles in interaction

As designers, we understand that beautiful or innovative human-computer interfaces are proficient in completing the required task while being artistically pleasing (Dix *et al.*, 2004:6). In order to replicate a good interface, we would like to reuse lessons from the past (Dix *et al.*, 2004:6). It is true that innovative ideas tend to lend themselves towards the creation of more usable systems, but in order to fully benefit from innovative ideas, we need to not only understand the fact that they work, but also how they work and why they work (Dix *et al.*, 2004:6). Just as a civil engineer is able to construct a bridge and be sure that it will stand, this aforementioned form of rationalisation will allow designers to reuse related concepts within similar situations as it is based upon a set of principles that have been both tried and tested (Dix *et al.*, 2004:6).

As mentioned in this chapter, individuals differ. It is therefore unrealistic to expect a designer to rely merely on artistic skill and a perfect sense of insight to create systems that are deemed usable by the user (Dix *et al.*, 2004:6). Through the use of human-computer interaction principles, designers are provided with an understanding of the different types of concepts involved and a scientific perspective which reflects why certain features are successful and others are not (Dix *et al.*, 2004:6). Designers can then use these scientific human-computer interaction principles as a springboard for

their creative flow which is supported by science and fast-tracked by artistic insight (Dix *et al.*, 2004:6).

5.5.4 What are the HCI principles?

As the field of computers grew, so did the amount of researchers who specialised in the field of interaction between humans and computers. These researchers observed the theoretical, psychological, and physical aspects of the interaction process (Dix *et al.*, 2004:3). As a result of this, there are a number of proposed human-computer interaction principles. An overview of several HCI principles given in literature is given in Table 5.3.

Table 5.3: Summary of several HCI principles given in literature.

Author	Principles
Human-computer interaction principles as given by Norman (1983:257).	1. Feedback – The user should be able to clearly see the state of the system in a form that is straightforward and clearly defines the options that are available in order to prevent mode errors. 2. Similarity of response sequences – Different categories of actions should have different command sequences in order to prevent capture and description errors. 3. Actions should be reversible – in order to prevent unintentional performance, actions should be reversible and hard to do in instances where actions should be irreversible and are of quite a high consequence. 4. Consistency – The structure and design of a system should be consistent in order to minimise the occurrence of memory problems in retrieving the required operations.
Human-computer interaction principles as given by Shneiderman and Plaisant (2005:74).	1. Strive for consistency. 2. Cater to universal usability. 3. Offer informative feedback. 4. Design task flows to yield closure. 5. Prevent errors. 6. Permit easy reversal of actions. 7. Make users feel they are in control. 8. Minimise short-term memory load.

Human-computer interaction principles as given by Nielsen and Molich (1990:249).	1. Consistency and standards. 2. Visibility of system status. 3. Match between system and real world. 4. User control and freedom. 5. Error prevention. 6. Recognition rather than recall. 7. Flexibility and efficiency of use. 8. Aesthetic and minimalist design. 9. Help users recognise, diagnose and recover from errors. 10. Provide online documentation and help.
Human-computer interaction principles as given by Stone <i>et al.</i> (2005:97).	1. Visibility – The first step in order to achieve the goal should be clear. 2. Affordance – The control should suggest how the user should use it. 3. Feedback – What happened or is happening should be clear. 4. Simplicity – As simple as possible and task-focused. 5. Structure – Sensible organisation of content. 6. Consistency – Similarity for predictability. 7. Tolerance – Prevent errors and aid in recovery. 8. Accessibility – Usable by all intended users in spite of handicap, or environmental conditions.
Human-computer interaction principles as given by Johnson (2007:8).	1. Focus on the users and their tasks, not on the technology. 2. Consider function first, presentation later. 3. Conform to the users' view of the task. 4. Design for the common case. 5. Do not complicate the user's task. 6. Facilitate learning 7. Deliver information, not just data. 8. Design for responsiveness. 9. Try it out on users; then fix it.

Principles to support usability as given by Dix <i>et al.</i> (2004:261).	Principles for learnability – how easily new users can effectively interact and achieve maximum performance. 1. Predictability – enable the user to determine effects of future action based on interaction history. 2. Synthesisability – enable the user to judge the effect that past operations had on the current system state. 3. Familiarity – how much of a user's computer-based or real-world experience and knowledge can be applied to the interaction with the new system. 4. Generalisability – the ability of a user to apply the same knowledge in different applications or situations. 5. Consistency – provide a consistent and therefore predictable environment for the user. Principles for flexibility – the array of information exchange between user and system. 1. Dialog initiative – Do not restrict the user by allowing the system to impose constraints on the input dialog. 2. Multi-threading – a system's ability to sustain user interaction with more than one task at the same time. 3. Task migratability – the ability to pass the control of the execution of a task between the user and the system. 4. Substitutivity – the allowing of equal input and output values to be substituted with each other. 5. Customisability – the ability of a user to modify the user interface. Principles for robustness – the amount of support a user has in determining the achievement and assessment of goals. 1. Observability – the capacity a user has to assess the internal state of a system through its representation. 2. Recoverability – the ability of a user to correct actions that have yielded errors. 3. Responsiveness – the user's perception of the rate of communication with the system. 4. Task conformance – the extent of support that system services provide a user who wishes to perform certain tasks in a specific way.
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As seen in Table 5.3, many of the popular HCI authors share common HCI principles. Rogers *et al.* (2011:25), more popular names within the field of HCI, discusses popular design principles instead of proposing a new list. The list of popular design principles as given by Rogers *et al.* (2011:25) are: visibility, feedback, constraints, consistency and affordance. Dix *et al.* (2004:261) proposed a new structure for the presentation of design principles by categorising their usability principles in order to extend the list as knowledge in the field increases. Hinze-Hoare (2007:1) conducted an in-depth review and analysis of human-computer interaction principles that include those mentioned in Table 5.3 and others such as Maxwell (2001:191) and Myers (1998:44). In doing so, Hinze-Hoare (2007:7) attempts to normalise a range of proposed principles and to determine the principles that form the most significant set. The normalisation process began by conducting a survey that was based on the citation frequency of authors of HCI principles. Hinze-Hoare (2007:7) believed that authors who were most frequently cited would offer the most respected and therefore important HCI principles. Hinze-Hoare also used the citation frequency of authors as a means of weighting the authority of HCI principles.

The authors were weighted as a percentage of all the citations listed in the ranking. The HCI principles of each author were then placed within a matrix and subsequently factored into HCI categories. As a result of doing so, an entire set of HCI principles was drawn from the principles given by each significant author (Hinze-Hoare, 2007:8). Principles that were the most popular in terms of the literature were taken from many different authors. Principles that were the least popular were obtained from only one or two of the authors. At the end of the exercise, each HCI principle obtained had at least one author proposing it. Finally, Hinze-Hoare (2007:8) multiplied the weighting factor obtained from the citation frequency of a significant author by the number of times a certain HCI principle was proposed by the author in order to derive a ranking of HCI principles that needed to be established.

Once the fundamental principles of every significant author were examined, categorised and weighted, the top eight HCI rules were found to be those given in Table 5.4.

Table 5.4: Weighted HCI rules according to their frequency of use (Hinze-Hoare, 2007:8).

1	Recoverability	96
2	Familiarity	57
3	Consistency	57
4	Substitutivity	54
5	Task Migratability	40
6	Synthesisability	34
7	Predictability	32
8	Perceptual Ergonomics	31

Recoverability refers to the ability that users have to recover from any errors they may have made. Recoverability can occur both forward (Norman, 1983:257; Shneiderman & Plaisant, 2005:74) and backward (Nielsen & Molich, 1990:249; Shneiderman & Plaisant, 2005:74). In forward recoverability, errors are prevented. This is usually engineered into and initiated by the system. In backward recoverability, the easy reversal of errors is facilitated. This usually concerns the user's actions and is initiated as a result of them.

Familiarity concerns the degree to which the real world experience and knowledge of a user can be drawn upon in order to understand how a new system works (Nielsen & Molich, 1990:249; Hinze-Hoare, 2007:10). Familiarity can drastically reduce the amount of time and knowledge that is needed in order to work a new system.

Consistency can be defined as a similar behaviour that arises from similar task objectives or situations. Many authors consider consistency to be a vital principle of human-computer interaction. This is reflected in the fact that consistency is the most quoted principle amongst all HCI authors (Norman, 1983:257; Nielsen & Molich, 1990:249; Shneiderman & Plaisant, 2005:74; Stone *et al.*, 2005:95; Johnson, 2007:8).

Substitutivity relates to the ability that a user has to perform the same action or enter the same value in various ways according to the user's individual experience (Hinze-Hoare, 2007:11). An example of this would be the ability to copy and paste using either the mouse or keyboard shortcuts.

Task migratability refers to the transferring of control between the user and the computer. An example of task migratability is requesting the computer to perform a spell check on a document. Maxwell (2001:191) states that he considers task migratability as a high level of interaction.

Synthesisability refers to the ability of the user to predict what actions can be performed next based on his use of the system (Hinze-Hoare, 2007:11), which in turn helps the user to construct a framework of all the possible actions that he can perform.

Synthesisability is closely linked with predictability which supports the user in determining the effect of future actions based on the past knowledge the user has of operating the system (Hinze-Hoare, 2007:11).

Finally, perceptual ergonomics involves the tracking of the manner in which humans perceive events in order to make an interface that is efficient for humans to use (Hinze-Hoare, 2007:11).

This concludes the overview of the most common human-computer interaction principles. Based on the above review of human-computer interaction principles, the researcher will be able to determine the principles that will be applicable for this study.

5.5.5 Chosen HCI principles for this study

Although all human-computer interaction principles are important, not all of them will be applicable to a digital graphic novel. As a result of this, the researcher has identified a set of human-computer interaction principles that will be applied within the context of this study. The selected human-computer interaction principles that will be used within this study are:

Consistency (Norman, 1983:257) – The structure and design of a system should be consistent in order to minimise the occurrence of memory problems in retrieving the required operations. The design should exhibit similarity for predictability (Stone *et al.*, 2005:170). This principle is applied within the digital graphic novel, *The Thrill Electric* (Moore & Reppion, 2015) as indicated in Figures 5.4 and 5.5. Although the frames of the digital graphic novel change, the overall look-and-feel of the web page that contains it remains the same.



Figure 5.4: The consistency principle incorporated in the structure of The Thrill Electric (Moore & Reppion, 2015).

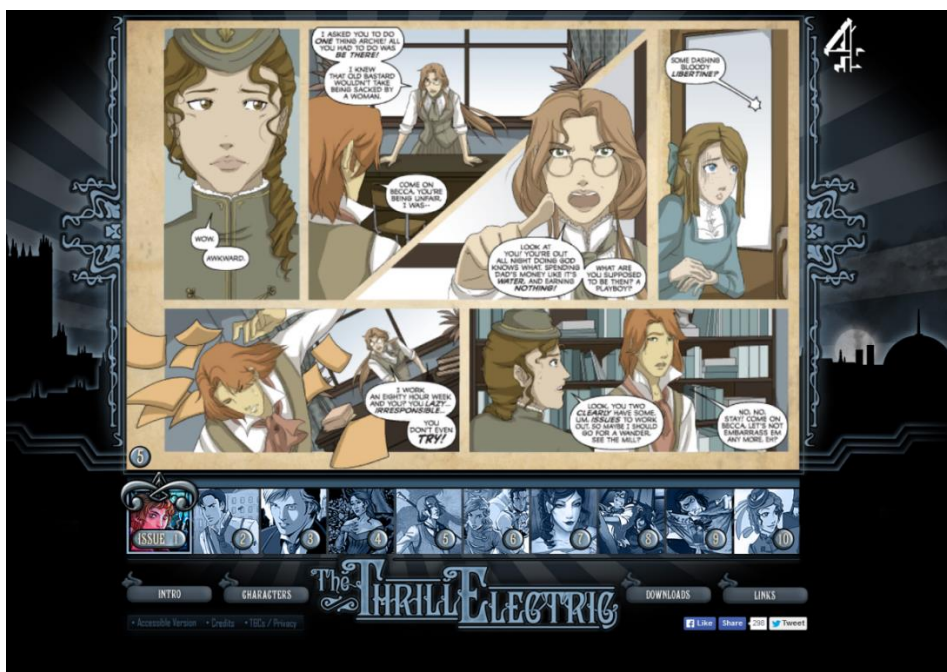


Figure 5.5: The consistency principle incorporated in the structure of The Thrill Electric (Moore & Reppion, 2015).

Cater to universal usability (Shneiderman & Plaisant, 2005:74) – *The Thrill Electric* (Moore & Reppion, 2015) demonstrates this in its navigation bar (Figure 5.6) by making use of directional arrows and buttons which have icons that make their function clear to the user without the need for text.



Figure 5.6: The navigation bar from *The Thrill Electric* (Moore & Reppion, 2015).

Prevent errors (Shneiderman & Plaisant, 2005:74) – An example of this principle can be found when a user tries to use a backslash “\” in the name of a file (Figure 5.7). A computer interprets a backslash as a new directory. Therefore, if a file is saved with the name this\text.doc the computer will interpret ‘this’ as a directory and text.doc as the file within the non-existent directory (Figure 5.8). To prevent errors of this nature, the operating system does not allow the backslash to be entered in file names.

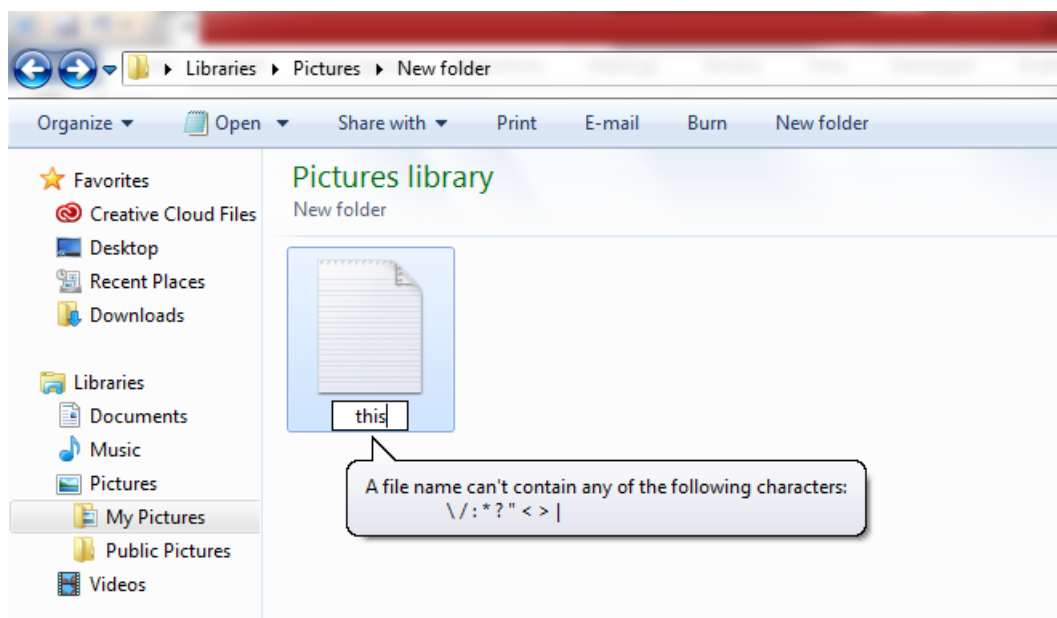


Figure 5.7: An error prevention method used by the Windows operating system when a user tries to enter a backslash in a file name.

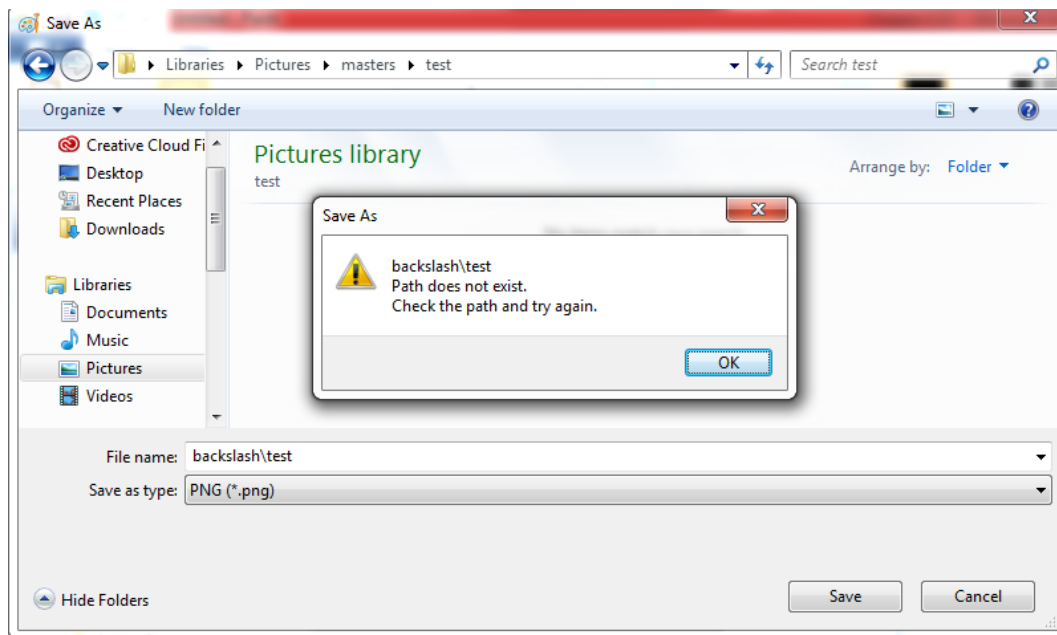


Figure 5.8: An error prevention method used by the Windows operating system when a user tries to enter a backslash in a file name.

Permit easy reversal of actions (Shneiderman & Plaisant, 2005:74) – The ‘back’ button in an internet browser facilitates this by allowing the user to revert back to the previous webpage without having to type in the URL again (Figure 5.9).

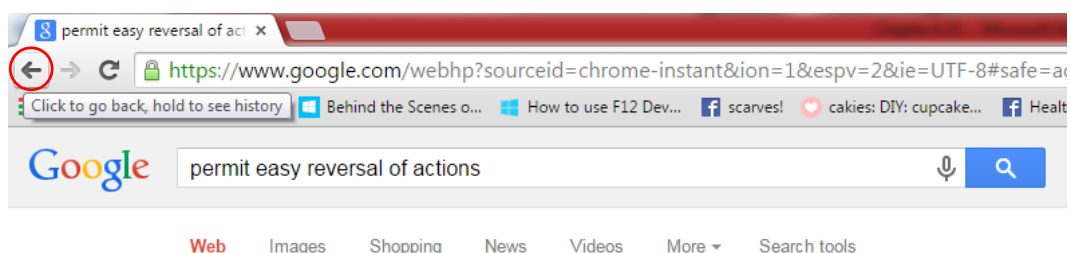


Figure 5.9: The ‘back’ button in a web browser (www.google.com).

Make users feel they are in control (Shneiderman & Plaisant, 2005:75). Within *The Thrill Electric* (Moore & Reppion, 2015) the navigation bar only appears if the user moves the cursor to the bottom of the screen. Users are also given the option to read all the instructions or skip through them (Figure 5.10).



Figure 5.10: Instruction screen in *The Thrill Electric* (Moore & Reppion, 2015).

Aesthetic and minimalist design (Nielsen & Molich, 1990:249) – This goes hand-in-hand with the simplicity principle which states that the designer should keep the interface as simple as possible and task-focused (Stone *et al.*, 2005:170). The Google landing page encompasses these principles by displaying only important links and showing only the Google search bar in the middle of the webpage (Figure 5.11).

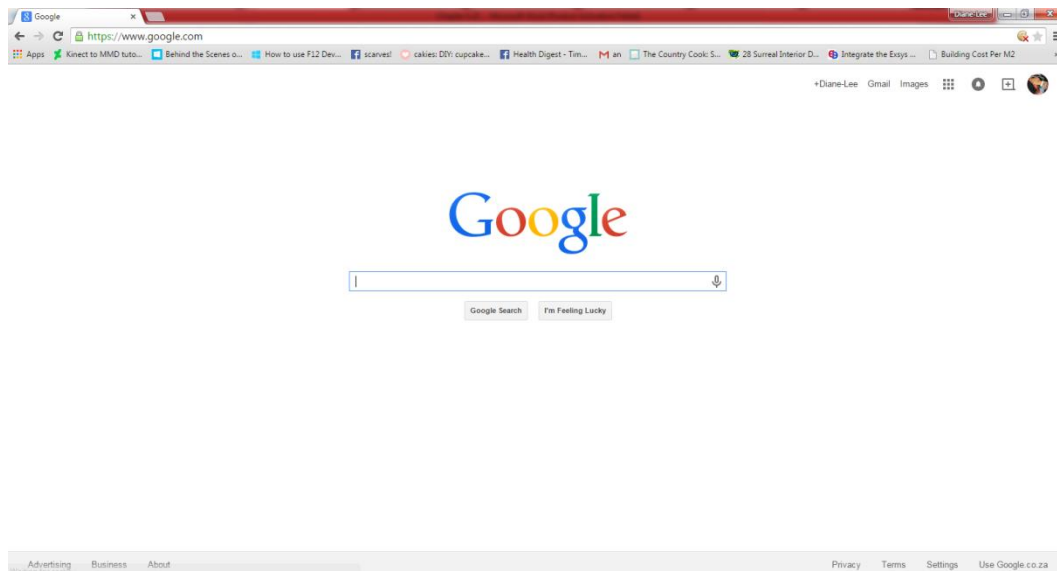


Figure 5.11: Google landing page (www.google.com).

Provide documentation and help (Nielsen & Molich, 1990:249) – *The Thrill Electric* (Moore & Reppion, 2015) provides a help menu to assist the reader in understanding the functions of each navigation button (Figure 5.12).



Figure 5.12: The help menu from *The Thrill Electric* (Moore & Reppion, 2015).

Structure (Stone *et al.*, 2005:97) – Sensible organisation of content. *The Thrill Electric* (Moore & Reppion, 2015) exhibits this principle by clearly indicating the current page in the middle of the screen and the other volumes of the graphic novel at the bottom of the screen (Figure 5.13).

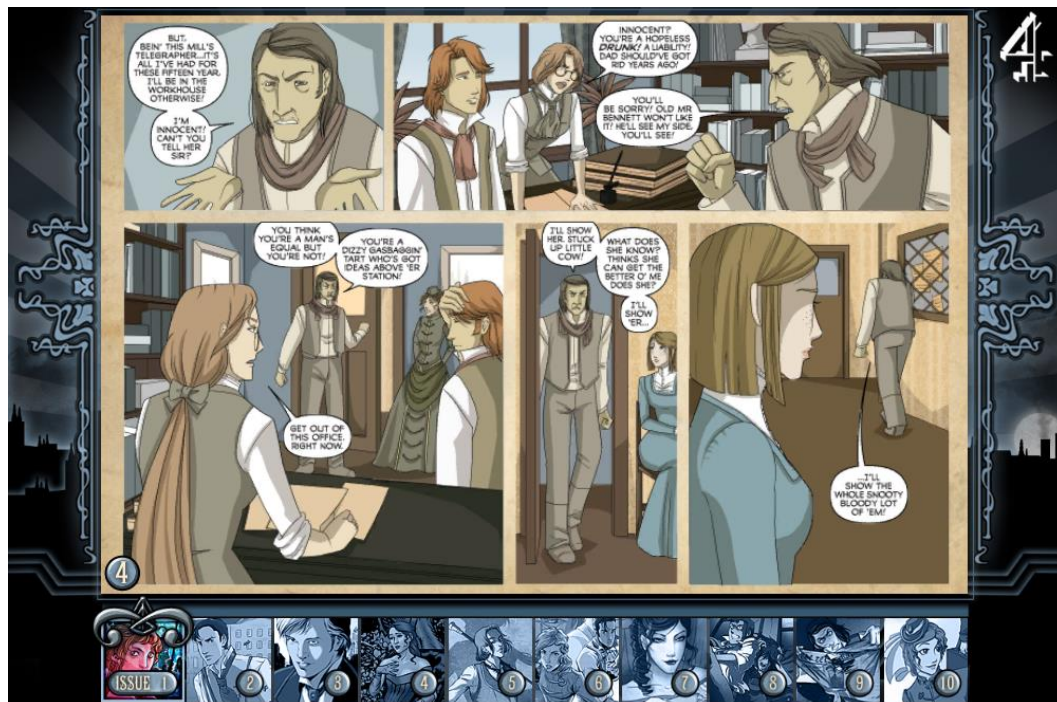


Figure 5.13: The organisation of content within *The Thrill Electric* (Moore & Reppion, 2015).

Accessibility (Stone *et al.*, 2005:177) – Usable by all intended users in spite of handicap, or environmental conditions. The Google landing page is once again a good example. In this case, a user can search the web not only by typing, but also by saying ‘Ok, Google’ and articulating what they would like to search.

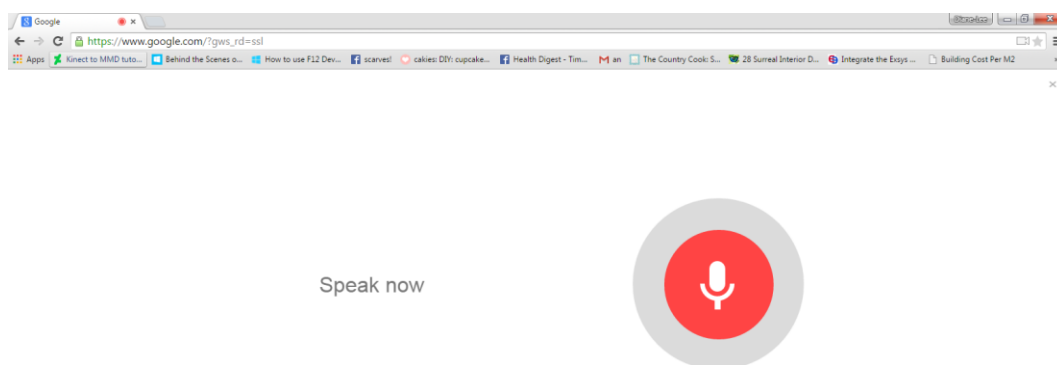


Figure 5.14: Google’s voice recognition search function (www.google.com).

Try it out on users; then fix it (Johnson, 2007:48) – Google has created a ‘Google Usability’ page where users can provide product feedback directly to Google (Figure 5.15).

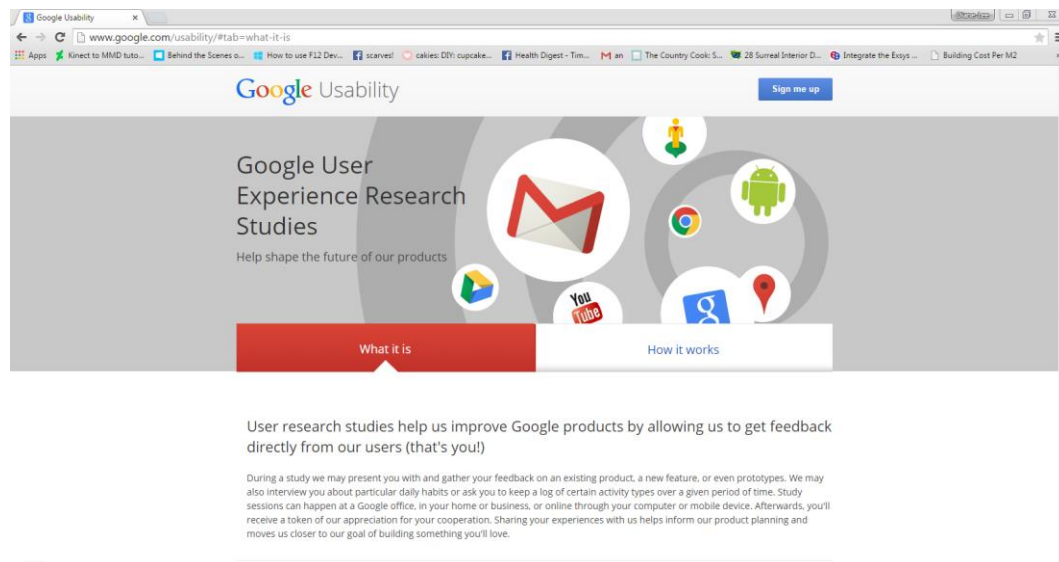


Figure 5.15: Google’s usability feedback page (<http://www.google.com/usability/>).

The researcher believes that the aforementioned principles can be applied to digital graphic novels that portray emotional social phenomena as they have been applied in environments that mimic the intended environment of the digital graphic novel to be created. By combining principles applied in an online digital graphic novel and interfaces that are familiar to users, the researcher aims to create an environment within the proposed digital graphic novel that is conducive to a positive user experience.

5.6 HCI enriched guidelines for creating digital graphic novels

The chosen HCI principles mentioned in the previous section have been used to enrich the original proposed guidelines for creating digital graphic novels portraying emotional social phenomena using critical systems heuristics discussed in Chapter 3. Table 5.5 provides proposed guidelines for creating digital graphic novels portraying emotional social phenomena using critical systems heuristics and HCI principles.

Table 5.5: Proposed guidelines for creating digital graphic novels portraying emotional social phenomena using critical systems heuristics and HCI principles.

Narrative	
N1	The author should determine the emotions, worldviews and the purpose for developing the narrative (McCloud, 1994:170).
N2	The author should make readers care about the narrative either by the content itself or through the intensity of its presentation (McCloud, 2011:53).
N3	The author should exploit the common experiences or heritage of the target group of the digital graphic novel to provoke emotions such as suspense, sadness and joy (McCloud, 2011:150).
N4	Complex information should not be presented in the narrative (Lutz & Huitt, 2003:3).
N5	A goal of the narrative should be to elicit a sense of meaningfulness from the reader (Lutz & Huitt, 2003:3).
N6	The narrative text should be presented as concise sentences and not paragraphs (Dix <i>et al.</i> , 2004:30).
N7	The narrative should be well-written in order to elicit emotions and activate emotional memory in readers (Sprenger, 1999:76; Lutz & Huitt, 2003:6).
Character	
C1	Characters should engage in novel and attention-grabbing conflicts with themselves, other characters and the world around them (McCloud, 2011:150).
C2	Characters should be designed as believable and vivid human beings (McCloud, 2011:62).
C3	Facial expressions of a character should be used to portray a character's emotions to the reader and to elicit emotions from the reader (Eisner, 1990:111; McCloud, 2011:81).
C4	A combination of and variation in the six basic emotional expressions should be used to represent more complex or intense emotions (McCloud, 2011:84).
C5	The body language of the character should be used to communicate the emotions of a character (Eisner, 1990:113; McCloud, 2011:103).
Pages and panels	
P1	Panels that enable the reader to easily follow the narrative should be used (McCloud, 2011:12).
P2	Each panel should lead to and support the next (Eisner, 1990:25; McCloud, 2011:14).
P3	The specific moment that is represented within a panel should serve to elicit emotions from readers or to portray emotion to readers (Eisner, 1990:46).
P4	Movement represented in panels should be one of six different types as given in literature (McCloud, 1994:70; McCloud, 2011:15). Moment-to-moment – series of moments portrays a single action. Action-to-action – series of actions of a single subject (person, object, etc.). Subject-to-subject – single scene with changing subjects. Scene-to-scene – moments that transition over significant distances of space or time. Aspect-to-aspect – moments transition from one aspect of a mood, place or idea to another. Non-sequitur – series of seemingly unrelated images and/or words.
P5	Frames should guide the reader's focus to aspects that are important to the narrative (McCloud, 2011:20).
P6	The variation of the look-and-feel of panels should be manipulated in order to elicit specific emotions from readers (Eisner, 1990:46)
P7	The flow of the digital graphic novel should adhere to the standard that readers will read frames from left-to-right and then top-to-bottom (Eisner, 1990:41; McCloud, 2011:32).

P8	By making use of the familiarity principle depth of field can be simulated within the digital graphic novel (Dix <i>et al.</i> , 2004:18).
P9	The thickness of lines and spaces between lines in the digital graphic novel should not fall outside an individual's ability to perceive it (Dix <i>et al.</i> , 2004:17).
P10	Luminance increases an individual's visual acuity (Dix <i>et al.</i> , 2004:17).
P11	By varying the brightness, size and depth of images within the digital graphic novel, a 2-dimensional image can be projected as a 3-dimensional image within the digital graphic novel (Preece <i>et al.</i> , 1994:83).
P12	The text in the digital graphic novel should not be written in capital letters in order to promote legibility and accuracy in reading (Dix <i>et al.</i> , 2004:22).
P13	Negative contrast (e.g. black text on a white background) should be used to increase the legibility of the text in a digital graphic novel (Dix <i>et al.</i> , 2004:23).
Artwork	
A1	The artist should decide on images that brings the narrative to life for the reader (Eisner, 1990:89; McCloud, 2011:26).
A2	Images should communicate the narrative clearly and compellingly (McCloud, 2011:26).
A3	Pictures should be used to evoke specific emotions or sensual responses from readers in order to increase immersion within the narrative (McCloud, 2011:118).
A4	Images should be combined with narrative text in seven distinct categories as given in McCloud (1994:153) and McCloud (2011:130). Word-specific – words describe everything that a reader needs to know while the pictures illustrate the scene described by the words. Picture-specific – opposite of word-specific; the pictures provide all the information that the reader needs while the words highlight certain aspects of the scene being shown. Duo-specific – the same message is portrayed by both words and pictures. Intersecting – both words and pictures make individual contributions to the scene while also working together in certain aspects to create the scene as a whole. Interdependent – neither the words nor the pictures would be able to convey the same message/idea on their own. Parallel – words and pictures do not seem to support each other or intersect. Montage – words and pictures are combined pictorially within a scene.
Interface	
I1	Features such as button highlights and page turning animations should help users to consolidate kinaesthesia without any physical feedback which may affect the performance and comfort of a user (Dix <i>et al.</i> , 2004:26).
I2	Research of the target audience of the digital graphic novel should be conducted in order for it to cater to their specific requirements, preferences and abilities (Dix <i>et al.</i> , 2004:52).
I3	The user should be able to determine what is going on and what to do next (Norman, 2002:188).
I4	Affordances should be made to account for a reader's physical, semantic, cultural and logical constraints (Norman, 2002:84).
I5	The structure and design of the interface of a digital graphic novel should be consistent in order to resolve memory problems and promote predictability (Norman, 1983:257; Nielsen & Molich, 1990:249; Shneiderman & Plaisant, 2005:74; Stone <i>et al.</i> , 2005:95; Johnson, 2007:8).
I6	The interface of a digital graphic novel should cater to universal usability (Shneiderman & Plaisant, 2005:74).
I7	The interface of a digital graphic novel should be designed so as to reduce errors (Norman, 1983:257; Shneiderman & Plaisant, 2005:74).

I8	The interface of a digital graphic novel should allow for easy reversal of actions (Nielsen & Molich, 1990:249; Shneiderman & Plaisant, 2005:74).
I9	The interface of a digital graphic novel should allow users to feel as though they are in control (Shneiderman & Plaisant, 2005:75).
I10	The interface of a digital graphic novel should be task-focused and as simple as possible (Nielsen & Molich, 1990:249; Stone <i>et al.</i> , 2005:170).
I11	There should be a help menu to assist readers in understanding the functions of each interface element (Nielsen & Molich, 1990:249).
I12	The content of the interface of a digital novel should be sensibly organised (Stone <i>et al.</i> , 2005:170).
I13	The interface of a digital graphic novel should enable all intended readers to read it regardless of environmental conditions or handicaps (Stone <i>et al.</i> , 2005:177).
I14	The interface of a digital graphic novel should be tested on members of the target audience and then altered to accommodate their preferences (Johnson, 2007:48).
Sound	
S1	Sounds used within the novel should fall between the appropriate intensity and frequencies of human hearing while not being too similar or too loud (Dix <i>et al.</i> , 2004:24; Te'eni <i>et al.</i> , 2007:75).
S2	A digital graphic novel should make use of sounds in order to elicit emotions and activate emotional memory in readers (Sprenger, 1999:76; Lutz & Huitt, 2003:6).

The categories of 'interface' and 'sound' have been added to the enriched proposed guidelines for creating digital graphic novels portraying emotional social phenomena using critical systems heuristics and human-computer interaction principles (Table 5.5). Although these categories are not part of the fundamental requirements of sequential art as given by Eisner (1990:159), they play an important role within the human-computer interaction process due to digital nature of the digital graphic novel. For this reason, the aforementioned categories need to be represented in the enriched proposed guidelines presented in this chapter.

5.7 Conclusion

In this chapter, the researcher identified 10 HCI principles that can be applied in the development of a digital graphic novel portraying emotional social phenomena. These principles have been used to enrich the proposed guidelines for creating digital graphic novels portraying emotional social phenomena using critical systems heuristics and human-computer interaction principles.

The next chapter will focus on emotion – one of the distinguishing factors of humans – and emotional social phenomena. The guidelines given in the previous section will then be further enriched in order to develop a set of guidelines for designing digital graphic novels portraying emotional social phenomena using critical systems heuristics and human-computer interaction principles. These enriched guidelines will then be incorporated within the design of the digital graphic novel that takes place within the action planning and action taking phases of this study. This is represented in Figure 5.16.

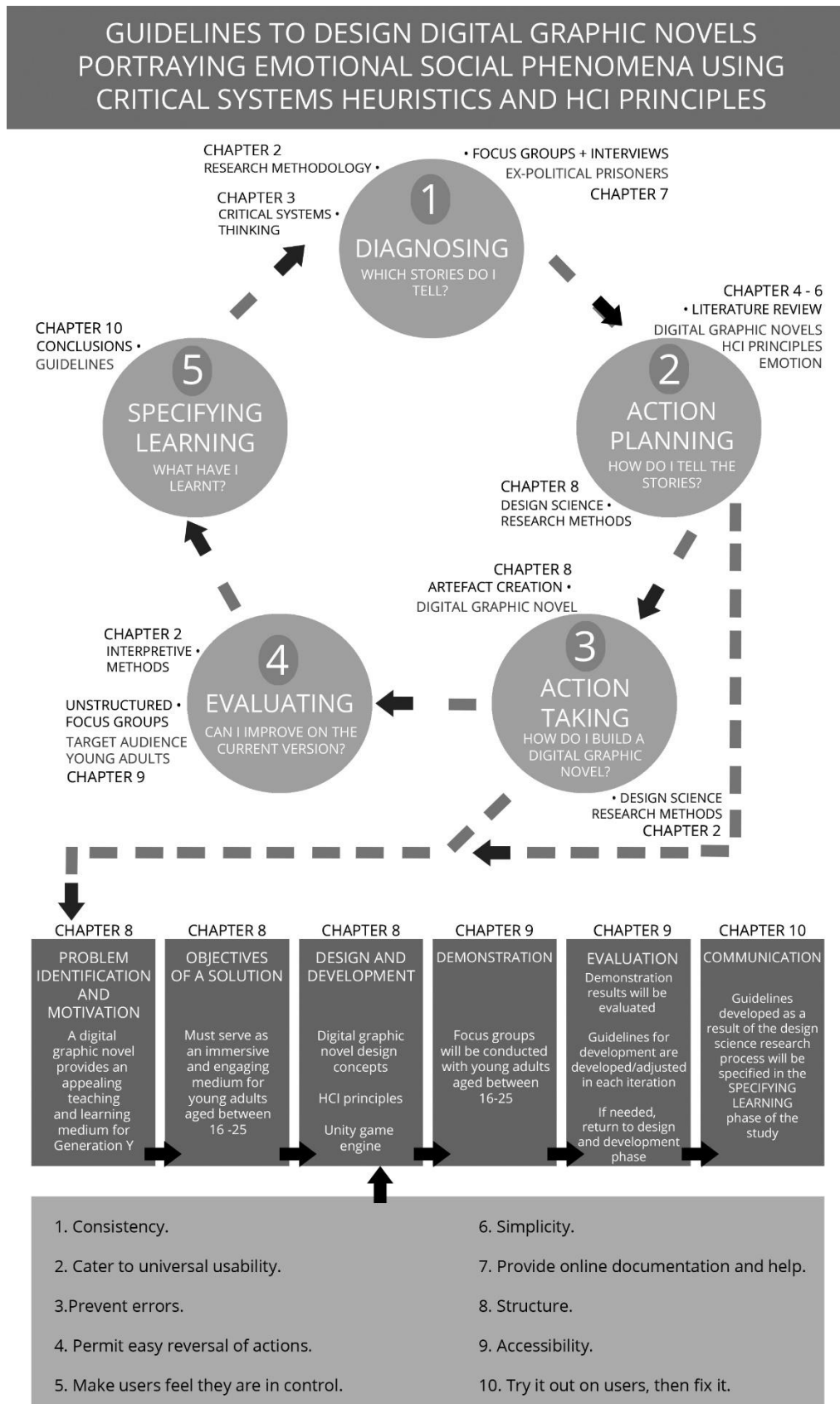


Figure 5.16: Adaptation of the research structure that reflects the role of HCI principles in this study.

6 Chapter Six: Emotion

6.1 Introduction

The aim of this study is to formulate a set of guidelines to aid in the development of digital graphic novels that will be used to portray emotional social phenomena using critical systems heuristics and HCI principles. In this chapter, the proposed guidelines identified in Chapter 4 and Chapter 5 will be enriched by a literature review of emotion.

Although not a human sense like those mentioned in Chapter 5, emotion plays a critical part in the performance of an individual (Preece *et al.*, 1994:150; Dix *et al.*, 2004:51). The researcher believes that in order to develop guidelines for designing digital graphic novels portraying emotional social phenomena, one must understand the terms emotion and emotional social phenomena.

Due to the lack of literature regarding the term emotional social phenomena, emotions and a proposed definition of the term emotional social phenomena will be discussed in Section 6.2. The links between emotion and sight and emotion and sound will be discussed in Section 6.3 and Section 6.4 respectively. Emotions and HCI will be discussed in Section 6.5 and emotions in digital graphic novels will be briefly recapped in Section 6.6. Emotion-enriched guidelines for creating digital graphic novels portraying emotional social phenomena using critical systems heuristics and HCI principles will be presented in Section 6.7. The chapter will conclude with a summary and reflection of the chapter (Section 6.8).

6.2 Overview of emotions and emotional social phenomena

There are two main approaches that are used to structure emotion – the discrete approach and the dimensional approach. The discrete approach asserts the existence of ‘universal emotions’ (Plutchik & Kellerman, 1980:3; Ekman, 1992b:169; Izard, 1992:561). According to the literature, these ‘universal emotions’ are historically evolved basic emotions and, as a result, can be found in all cultures (Ekman, 1992a:550). Although there are several psychologists who have suggested various different basic emotions, there is significant agreement on six basic emotions, namely – sadness, happiness, fear, disgust, anger and surprise (Ekman, 1992b:170; Peter &

Herbon, 2006:142). While no distinct patterns for the six basic emotions could be agreed upon, there are several arguments in support of their existence such as their presence in other primates and distinctive facial expressions (Ekman, 1992b:170). In his research, Ekman (1992b:178) found that the facial expressions associated with different emotions were recognised by individuals from varying cultures which enabled him to justify his assertion of 'universal emotions'.

The dimensional approach presupposes the existence of two or more major dimensions which have the ability to both describe the various emotions and distinguish between them (Russell, 1980:1161). Theories relating to the dimensional approach to emotion describe emotions by making use of dimensions instead of distinct categories (Peter & Herbon, 2006:143). The dimensional view of emotions assumes that all emotions are characterised by the dimensions of arousal and valence (Russell, 1983:1286; Peter & Herbon, 2006:143). Although it is understood that arousal and valence are not claimed to be the only two dimensions or deemed able to sufficiently and equally differentiate between the various emotions, they have proven to be the two main dimensions (Russell, 1983:1286). As a result, valence and arousal are referred to in the explanation of the dimensional approach in this study. Russell and Feldman Barrett (1999:805) offer a review of alternative dimensional theories that may also be used. Peter and Herbon (2006:143) agree that there has been a considerable amount of controversy associated with the naming of the two dimensions of the dimensional approach. This is further discussed by Feldman Barrett and Russell (1998:967), but is beyond the scope of this study.

Although there have been attempts to merge both the discrete and dimensional approaches by Russell and Feldman Barrett (1999:805), there are still disputes as to which approach best represents the structure of emotion. With this incongruence in the definition of the structure of emotion, it is easy to see why there are various definitions for emotion within the literature (Cabanac, 2002:69). For the purposes of this study, the researcher will categorise emotions as either being positive (e.g. happiness) or negative (e.g. sadness) as proposed by Cacioppo and Gardner (1999:203). In addition, for the purposes of this study, the researcher will make use of the definition supplied by Te'eni *et al.* (2007:112) which defines emotion as "a core affect that is intentional and directed towards a certain object". To elaborate on this

definition, the word *affect* can be defined as a set of psychological states and processes which include emotions, moods and attitudes (Te'eni *et al.*, 2007:111).

As mentioned earlier, humans have a set of core affects that include feeling sad, satisfied, delighted, etc., which they direct towards other objects – usually other humans, events, conditions or things. For the purpose of this study, we will assume that the object that a human directs his core affect towards is a computer. The concern over how a user feels and reacts when interacting with a particular technological product can be defined as emotional interaction (Rogers *et al.*, 2011:128).

Affective quality can be defined as the ability an object possesses in terms of altering the user's core affect (Te'eni *et al.*, 2007:113). For example, some individuals might find that the rhythm of certain types of music calms them. The affective quality of music in such cases can therefore be defined as its rhythm because a change in the rhythm will result in a change in the individuals core affect. Similarly, the human-computer interface serves as the affective quality of a computer system (Te'eni *et al.*, 2007:113). Research conducted by (Zhang & Li, 2005:107) found affective qualities to be present in both websites and screens, namely – beauty, overview, title, shape, structure, texture, menu, main images and colour.

Moon and Kim (2003) further identified two affective qualities of online content – interactivity and vividness. Interactivity can be defined as the extent to which a human can communicate and interact with a computer in real time (Te'eni *et al.*, 2007:114). The factors that influence interactivity are (Te'eni *et al.*, 2007:114):

- The speed of a user's actions and effects.
- The range of a user's actions.
- The mapping of a user's actions to effects.

Vividness relates to the richness of the content that is represented within a human-computer interface (Te'eni *et al.*, 2007:114). The influencing factors of vividness are sensory breadth (e.g. auditory and visual aspects) and sensory depth (e.g. the resolution of the screen) (Te'eni *et al.*, 2007:114).

Emotion (affect) and cognition interact with and influence each other (Te'eni *et al.*, 2007:119). Humans who are subjected to positive emotions are able to solve complex

problems and are more prone to creative thinking, while humans who are subjected to negative emotions tend to engage in more narrow and focused thinking patterns (Preece *et al.*, 1994:150; Dix *et al.*, 2004:51). An example of this would be to imagine writing a test without any time limit and no marking system versus writing a final year school exam. In order to ensure the positive performance of a human user and to adequately adjust the human-computer interface, it is important to understand the effect that emotion has on cognition (Te'eni *et al.*, 2007:119). When a user experiences a sense of anxiety, the attention level of the human drops as it is divided between cognition and the predisposition of attention towards the identified sources of danger (Te'eni *et al.*, 2007:119). Te'eni *et al.* (2007:119) also state that while positive affects¹⁴ of humans positively influence their self-control and ability to recall positive information, negative affects tend to negatively influence the self-control of a human as he interprets ambiguous stimuli as being threatening. The final link between affect and cognition that will be discussed is that of the link between the obsessiveness of a human and the performance of a human. If a human possesses an affect of obsessive behaviour, he may take longer to make decisions and have a degree of insecurity due to his inability to recollect recent events or to distinguish between events that were real or imagined (Te'eni *et al.*, 2007:119).

A number of theories regarding emotional design have been developed within the field on interaction design or even introduced from other fields. The goal of these theories is to aid designers in understanding the way in which users may respond or react within different contexts. Understanding this will enable designers to know how to design in order to reduce or increase certain emotions (Rogers *et al.*, 2011:149). A few popular theories regarding emotional design include research by Norman (2005:21), Ortony, Norman and Ravelle (2005:173), Jordan (2000) and McCarthy and Wright (2007). Table 6.1 offers a summary of these popular emotional design theories. Norman (2005:21) states that a user's emotional attachment and involvement with a product is of equal importance to a product's ease of use. Furthermore, users are more likely to have a positive experience if they find the look and feel of a product pleasing (Jordan, 2000:13; Norman, 2005:2; Ortony *et al.*, 2005:173). A number of techniques can be used in order to enable a product to feel, sound and look good. These

¹⁴ The word 'affect' can be defined as a set of psychological states and processes which include emotions, moods and attitudes (Te'eni *et al.*, 2007:111).

techniques include clean lines, balance, colour, shape and texture (Rogers *et al.*, 2011:150).

Table 6.1: Summary of popular emotional design theories.

Author	Emotional design theory
Norman (2005) Ortony <i>et al.</i> (2005)	Emotional design model • The affective state¹⁵ of an individual, whether positive or negative, affects the way the individual thinks. • Three different levels of the brain interact with and affect each other. ○ Visceral level – lowest level that responds to events occurring in the physical world. ○ Behavioural level – middle level that controls an individual's everyday behaviour. ○ Reflective level – highest level of the brain where an individual contemplates. • Designers must incorporate all levels in their design. ○ Visceral design ensures that the product looks, feels, and sounds good. ○ Behavioural design ensures that a product is usable. ○ Reflective design incorporates personal value and meaning that a certain product has in a specific culture.
Jordan (2000)	Pleasure Model The pleasure model aids designers to be mindful of the different types of pleasure that users experience and to incorporate these into the design of a product. The different types of pleasure are: • Socio-pleasure – the joy of being in the company of others. • Physio-pleasure – pleasures linked to sensory events such as sight, touch, smell, sound and taste. • Psycho-pleasure – the cognitive and emotional reactions of users toward a product. • Ideo-pleasure – the values of an individual. Similar to reflective design in the emotional design model.

¹⁵ Affective state: Refers to emotions, moods and attitudes (Te'eni *et al.*, 2007:111).

McCarthy and Wright (2007)	Technology as Experience Framework Although experience cannot be defined, it can be broken down into four interrelated threads. The aim of the framework is to aid designers in considering the entire experience of a product rather than a single aspect such as marketability or usability. The four interrelated threads that comprise experience are: • Compositional thread – the manner in which an individual makes sense of an experience; the narrative part of an experience. • Spatio-temporal thread – the time and space in which experiences take place and the effect of time and space on an experience. • Sensual thread – focuses on a user’s sensory engagement in a situation. This is similar to the visceral level in the emotional design model.
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The researcher believes that it is important to keep these techniques in consideration when designing a digital graphic novel portraying emotional social phenomena in order to ensure that the intended user finds it pleasing to work with. This belief is substantiated by a claim made by Picard and Daily (2005:2120) which states that the efficiency of a human-computer interaction (HCI) depends greatly upon the ability of the computer-based application to interpret the affective states of users, to express emotions and to understand the role that the internal and external influences play on effective responses. A key question when considering qualities and experiences with regard to human-computer interaction is whether a user’s emotions are legitimate factors in the user’s interaction with the technology and, if so, which emotions are of key significance (Schrammel *et al.*, 2006). The researcher believes that in designing digital graphic novels portraying emotional social phenomena, a user’s emotions are legitimate factors in the user’s interaction with the technology and it is important for the designer to understand the emotions that are of key significance to the emotional social phenomena being covered.

As mentioned in the previous section, because of the content that will be represented within the digital graphic novel, it is also important to understand the emotions involved within the emotional social phenomenon in order to correctly portray them to others.

The term emotional social phenomenon does not exist in any literature to date, and as a result, the researcher aims to define it by its individual terms:

- Emotional – readily or excessively affected by emotion (Kuether, 2003:537).
- Social – of, relating to, or characteristic of the experience, behaviour and interaction of persons forming a group (Kuether, 2003:1531).
- Phenomenon – any remarkable occurrence or person (Kuether, 2003:1221).

Therefore, the researcher proposes that the definition of an emotional social phenomenon should be as follows: the experience, behaviour and interaction of a large group of individuals regarding a remarkable occurrence that is excessively affected by emotion. By the aforementioned definition, emotional social phenomena include racism, sexism, war, the effects of AIDS, etc. The experience, behaviour and interaction of members of a volleyball team after a win would not be considered as an emotional social phenomenon. The researcher believes that familiarity with the term emotional social phenomenon is vital to the investigation of the emotions regarding the phenomenon and as a result, to the design of digital graphic novels portraying emotional social phenomena. The following sections will explore the correlation between various factors and emotion.

6.3 Emotion and sight

The researcher believes that due to the graphic nature of the digital graphic novel, it is important to understand the emotions associated with an individual's perceptions of colour. Studies conducted by Guilford and Smith (1959:490) investigated colour preferences in individuals with regard to hue, saturation, and brightness. These studies produced the following ranking of hues ranging from least preferred to most preferred: yellow, orange, red, violet, purple, green and blue. Guilford and Smith (1959:502) further found that more saturated and brighter colours tend to elicit greater pleasure from individuals. The relationship between brightness, saturation and pleasure was found to be of a curvilinear nature.

Terwogt and Hoeksma (1995:7) maintained that the link between colours and emotions could be rationalised through the basis of colour preferences and emotion preferences. Terwogt and Hoeksma (1995:11) proposed that colours that are highly

preferred should be linked to emotions that are highly preferred. On the other hand, colours that are non-preferred should be linked to a non-preferred emotion. Terwogt and Hoeksma (1995:11) state that it is unlikely for a preferred colour to be linked to a non-preferred emotion and vice versa. The results of their research found that in groups of 7- and 11-year-old children colours and emotions that were further apart in terms of preferences (such as the colour black which was least preferred and the emotion happy that was most preferred) were less likely to be combined. However, the research of Terwogt and Hoeksma (1995:12) also revealed that the effect of preference in regard to colours and emotions decreased with age. For example, the most preferred emotion, happiness, was not associated with the most preferred colour, blue, but rather with the colour yellow.

Wexner (1954:433) conducted a study that covered the associations adults have between colour samples and words that describe certain types of feelings. In his findings, Wexner (1954:433) reports that the colour red was associated with the words 'exciting' and 'stimulating'. The colour blue was associated with 'secure/comfortable' and 'tender/soothing', while orange was associated with 'disturbing/distressed/upset' and black was associated with 'powerful/strong/masterful'. Weller and Livingston (1988:438) explored the effects of the colour of paper on which text was printed and presented to participants. The text on the paper contained information about murder and rape incidents. The participants were asked to read the text and then describe their emotional reactions to the incidents contained within the text. Weller and Livingston (1988:438) found that the exact same incidents were deemed less upsetting when described on pink paper as opposed to white or blue paper.

Adams and Osgood (1973:135) performed a study that was unlike any that preceded them by investigating the emotional reactions of individuals to colour concepts instead of the emotional and behavioural reactions of individuals to particular colour stimuli. In their cross-cultural study, Adams and Osgood (1973:135) required participants to rate colour concepts such as the words 'green' and 'blue'. The results of the study found that the colour red was strong and active; black was bad, inactive and strong; green and blue were good; yellow was bad and weak; grey was weak, bad and inactive; and white was good and weak (Adams & Osgood, 1973:145). Overall, the study also found that colour itself was deemed both good and active.

Research conducted by Valdez and Mehrabian (1994:398) found that individuals experienced colours with greater brightness and saturation to be more pleasant than others. Valdez and Mehrabian (1994:398) also found that individuals experienced colours that were less bright and more saturated to be more emotionally arousing than others were. The study further reported that both men and women responded with exceptionally similar emotional reactions to variations in the brightness and saturation of colours (Valdez & Mehrabian, 1994:407). The research revealed that brighter colours such as whites, light greys or colours that are lighter tend to be experienced as more pleasant, less dominance-inducing and less emotionally arousing than darker colours such as blacks or dark greys (Valdez & Mehrabian, 1994:407).

The research conducted by Detenber and Reeves (1996:76) is important for this study, since they found that individuals rate large, still versions of images as more emotionally arousing than small, still versions, small, motion versions and even large, motion versions of an image. The results of the experiment also showed that pictures seen as large images elicited stronger feelings of emotional arousal within individuals than when the same picture was seen as a small image (Detenber & Reeves, 1996:77). As a result of this research, the researcher believes that the correct use of image sizes will have a considerable effect on the impact of the digital graphic novel and should be carefully considered when planning the layout.

The researcher believes that the correlation between sight and emotion can play a vital role in the design of a digital graphic novel portraying emotional social phenomena and should therefore be properly understood and incorporated in the design process.

6.4 Emotions and sound

Sound can convey a large amount of information to an individual, however, it is rarely used to its full potential within the design of an interface (Dix *et al.*, 2004:23). Dix *et al.* (2004:24) suggest that sound could be more extensively used in interface design without confining it to warning sounds and notifications. Tajadura-Jiménez and Västfjäll (2008:63) agree with the statement made by Dix *et al.* (2004:24) and conducted research which showed the potential that sound has in inducing desired emotional states. Juslin and Västfjäll (2008:560) further substantiate these claims by establishing that sounds evoke emotions and can therefore supply affective

information with possibly even more effectiveness than various other forms of information channels available to HCI designers and researchers.

In their book '*How people treat computers, television, and new media like real people and places*', Reeves and Nass (1996) discuss the fact that individuals were found to be considerably more sensitive to audio fidelity than to visual fidelity. This translates into the statement that visual imperfections may be compensated for through the use of sound (Tajadura-Jiménez & Västfjäll, 2008:69). Tajadura-Jiménez and Västfjäll (2008:69) also stated that sound should be considered when planning the design of affective human-computer interfaces. This is because sound has the ability to elicit a full range of emotions in individuals. This claim is substantiated by research conducted by Västfjäll *et al.* (2012:5) which further showed that intense or arousing emotional experiences complement a user's engagement in media applications.

The researcher believes that a proficient understanding of the affective qualities of sound will enable the designer of a digital graphic novel that portrays emotional social phenomena to elicit the intended emotions from the user within each frame and page. This will result in greater user engagement and an improved user experience.

6.5 Emotions and HCI

Within almost the last three decades there has been a large movement towards a social and interactional approach to understanding cognition within human-computer interaction (Boehner *et al.*, 2007:276; Fuchs & Obrist, 2010:639; Choi *et al.*, 2015:41). Bearing in mind the prevalence of computers technology in our current everyday lives and the subsequent impact that it has on society, it is important to surpass natural-scientific conceptions of emotions and pay attention to users' actual emotional experiences surrounding technology (Boehner *et al.*, 2007:289). Studies conducted by Choi *et al.* (2015:49) found that emotional content in computers successfully influence the decision making of individuals by means of two processes – inferential and affective. In the inferential process, the expressions of emotion serve to provide information about the mental states of others. In the affective process, expressions of emotion on a computer serve to elicit emotion in the user. These emotions then impact the decisions made by the user (Choi *et al.*, 2015:49). Finally, research conducted by Rimé *et al.* (1998:148) found that if an individual experiences a certain emotion that is

salient enough for the individual to recall after a few hours, then, almost always, the individual confided or will confide the emotional experience to one or more other individuals.

The researcher believes that properly designing a digital graphic novel portraying emotional social phenomena will enhance its ability to influence the decision making of the intended audience. In addition, if the emotional experience elicited from the user through the digital graphic novel is salient enough, the user will most likely tell others about the digital graphic novel, which will serve to increase awareness of the emotional social phenomenon that it addresses.

6.6 Emotions in digital graphic novels

As discussed in Chapter 4, emotions can be graphically represented within the design of a digital graphic novel. The correlations between the design of a digital graphic novel and its role on emotion discussed in this study can be briefly summarised in the following statements:

- Frames can be used to portray a visual perspective of the emotional climate within which a certain action occurs (Eisner, 1990:46). The variation of shape or treatment of frames can also generate emotional involvement from the reader (Eisner, 1990:59).
- According to McCloud (2011:118), pictures can also evoke an emotional response as depicted in Figure 4.6 (Chapter 4). In fact, according to Eisner (1990:13), the failure or success of communicating through pictures lies within the ease with which the reader is able to recognise both the meaning and emotional impact of the selected image.
- The inner life of a character contains a character's life history which should help the reader emotionally connect with the character while also providing a platform from which differences in life experiences of the character and other characters can elicit stories worth being told (McCloud, 2011:65).
- Facial expressions in comics are important in order for the comic artist to portray the emotions of the characters to the readers as well as to provoke emotions in the readers themselves (McCloud, 2011:81).

The researcher believes that it is important to understand the correlation between the design of a digital graphic novel and its role on emotion due to the content that will be contained within a digital graphic novel portraying emotional social phenomena. In the following section, the aforementioned correlations between emotion and sight, sound, HCI and digital graphic novels will be used to enrich the guidelines for creating digital graphic novels portraying emotional social phenomena given in Chapter 5.

6.7 Emotion-enriched principles for creating digital graphic novels portraying emotional social phenomena

The investigation of emotion and emotional social phenomena presented in this chapter yielded many new factors that should be considered when creating a digital graphic novel portraying emotional social phenomena. To incorporate this new information, Table 6.2 presents an emotion-enriched set of guidelines for creating digital graphic novels portraying emotional social phenomena using HCI principles.

Table 6.2: Proposed guidelines for creating digital graphic novels portraying emotional social phenomena using critical systems heuristics and HCI principles.

Narrative	
N1	The author should determine the emotions, worldviews and the purpose for developing the narrative (McCloud, 1994:170).
N2	The author should make readers care about the narrative either by the content itself or through the intensity of its presentation (McCloud, 2011:53).
N3	The author should exploit the common experiences or heritage of the target group of the digital graphic novel to provoke emotions such as suspense, sadness and joy (McCloud, 2011:150).
N4	Complex information should not be presented in the narrative (Lutz & Huitt, 2003:3).
N5	A goal of the narrative should be to elicit a sense of meaningfulness from the reader (Lutz & Huitt, 2003:3).
N6	The narrative text should be presented as concise sentences and not paragraphs (Dix <i>et al.</i> , 2004:30).
N7	The narrative should be well-written in order to elicit emotions and activate emotional memory in readers (Sprenger, 1999:76; Lutz & Huitt, 2003:6).
Character	
C1	Characters should engage in novel and attention-grabbing conflicts with themselves, other characters and the world around them (McCloud, 2011:150).
C2	Characters should be designed as believable and vivid human beings (McCloud, 2011:62).
C3	Facial expressions of a character should be used to portray a character's emotions to the reader as well as to elicit emotions from the reader (Eisner, 1990:111; McCloud, 2011:81).
C4	A combination of and variation in the six basic emotional expressions should be used to represent more complex or intense emotions (McCloud, 2011:84).

C5	The body language of the character should be used to communicate the emotions of a character (Eisner, 1990:113; McCloud, 2011:103).
Pages and panels	
P1	Panels that enable the reader to easily follow the narrative should be used (McCloud, 2011:12).
P2	Each panel should lead to and support the next (Eisner, 1990:25; McCloud, 2011:14).
P3	The specific moment that is represented within a panel should serve to elicit emotions from readers or to portray emotion to readers (Eisner, 1990:46).
P4	Movement represented in panels should be one of six different types as given in literature (McCloud, 1994:70; McCloud, 2011:15). Moment-to-moment – series of moments portrays a single action. Action-to-action – series of actions of a single subject (person, object, etc.). Subject-to-subject – single scene with changing subjects. Scene-to-scene – moments that transition over significant distances of space or time. Aspect-to-aspect – moments transition from one aspect of a mood, place or idea to another. Non-sequitur – series of seemingly unrelated images and/or words.
P5	Frames should guide the reader's focus to aspects that are important to the narrative (McCloud, 2011:20).
P6	The variation of the look-and-feel of panels should be manipulated in order to elicit specific emotions from readers (Eisner, 1990:46).
P7	The flow of the digital graphic novel should adhere to the standard that readers will read frames from left-to-right and then top-to-bottom (Eisner, 1990:41; McCloud, 2011:32).
P8	By making use of the familiarity principle depth of field can be simulated within the digital graphic novel (Dix <i>et al.</i> , 2004:18).
P9	The thickness of lines and spaces between lines in the digital graphic novel should not fall outside an individual's ability to perceive it (Dix <i>et al.</i> , 2004:17).
P10	Luminance increases an individual's visual acuity (Dix <i>et al.</i> , 2004:17).
P11	By varying the brightness, size and depth of images within the digital graphic novel, a 2-dimensional image can be projected as a 3-dimensional image within the digital graphic novel (Preece <i>et al.</i> , 1994:83).
P12	The text in the digital graphic novel should not be written in capital letters in order to promote legibility and accuracy in reading (Dix <i>et al.</i> , 2004:22).
P13	Negative contrast (e.g. black text on a white background) should be used to increase the legibility of the text in a digital graphic novel (Dix <i>et al.</i> , 2004:23).
Artwork	
A1	The artist should decide on images that brings the narrative to life for the reader (Eisner, 1990:89; McCloud, 2011:26).
A2	Images should communicate the narrative clearly and compellingly (McCloud, 2011:26).
A3	Pictures should be used to evoke specific emotions or sensual responses from readers in order to increase immersion within the narrative (McCloud, 2011:118).
A4	Images should be combined with narrative text in seven distinct categories as given in McCloud (1994:153) and McCloud (2011:130). Word-specific – words describe everything that a reader needs to know while the pictures illustrate the scene described by the words. Picture-specific – opposite of word-specific; the pictures provide all the information that the reader needs while the words highlight certain aspects of the scene being shown. Duo-specific – the same message is portrayed by both words and pictures. Intersecting – both words and pictures make individual contributions to the scene while also working together in certain aspects to create the scene as a whole.

	Interdependent – neither the words nor the pictures would be able to convey the same message/idea on their own. Parallel – words and pictures do not seem to support each other or intersect. Montage – words and pictures are combined pictorially within a scene.
Interface	
I1	Features such as button highlights and page turning animations should help users to consolidate kinesthesia without any physical feedback which may affect the performance and comfort of a user (Dix <i>et al.</i> , 2004:26).
I2	Research of the target audience of the digital graphic novel should be conducted in order for it to cater to their specific requirements, preferences and abilities (Dix <i>et al.</i> , 2004:52).
I3	The user should be able to determine what is going on and what to do next (Norman, 2002:188).
I4	Affordances should be made to account for a reader's physical, semantic, cultural and logical constraints (Norman, 2002:84).
I5	The structure and design of the interface of a digital graphic novel should be consistent in order to resolve memory problems and promote predictability (Norman, 1983:257; Nielsen & Molich, 1990:249; Shneiderman & Plaisant, 2005:74; Stone <i>et al.</i> , 2005:95; Johnson, 2007:8).
I6	The interface of a digital graphic novel should cater to universal usability (Shneiderman & Plaisant, 2005:74).
I7	The interface of a digital graphic novel should be designed so as to reduce errors (Norman, 1983:257; Shneiderman & Plaisant, 2005:74).
I8	The interface of a digital graphic novel should allow for easy reversal of actions (Nielsen & Molich, 1990:249; Shneiderman & Plaisant, 2005:74).
I9	The interface of a digital graphic novel should allow users to feel as though they are in control (Shneiderman & Plaisant, 2005:75).
I10	The interface of a digital graphic novel should be task-focused and as simple as possible (Nielsen & Molich, 1990:249; Stone <i>et al.</i> , 2005:170).
I11	There should be a help menu to assist readers in understanding the functions of each interface element (Nielsen & Molich, 1990:249).
I12	The content of the interface of a digital novel should be sensibly organised (Stone <i>et al.</i> , 2005:170).
I13	The interface of a digital graphic novel should enable all intended readers to read it regardless of environmental conditions or handicaps (Stone <i>et al.</i> , 2005:177).
I14	The interface of a digital graphic novel should be tested on members of the target audience and then altered to accommodate their preferences (Johnson, 2007:48).
Sound	
S1	Sounds used within the novel should fall between the appropriate intensity and frequencies of human hearing while not being too similar or too loud (Dix <i>et al.</i> , 2004:24; Te'eni <i>et al.</i> , 2007:75).
S2	A digital graphic novel should make use of sounds in order to elicit emotions and activate emotional memory in readers (Sprenger, 1999:76; Lutz & Huitt, 2003:6).
Emotion	

E1	The six basic emotions sadness, happiness, fear, disgust, anger and surprise are universal, can be found in all cultures (Ekman, 1992b:170; Ekman, 1992a:550; Peter & Herbon, 2006:142) and should be incorporated into the characters of a digital graphic novel.
E2	The designer should pay attention to the affective qualities of the beauty, overview, title, shape, structure, texture, menu, main images and colour of websites and screens (Zhang & Li, 2005:107).
E3	The look and feel of the digital graphic novel should be pleasing to the reader in order to attain a positive user experience. (Jordan, 2000:13; Norman, 2005:2; Ortony <i>et al.</i> , 2005:173).
E4	The designer should make use of clean lines, balance, colour, shape and texture to enhance the look and feel of the digital graphic novel (Rogers <i>et al.</i> , 2011:150).
E5	More saturated and brighter colours should be used to elicit greater pleasure from readers (Guilford & Smith, 1959:502).
E6	Colours which are highly preferred should be linked to emotions which are highly preferred and vice versa (Terwogt & Hoeksma, 1995:11). Hues ranging from least preferred to most preferred are yellow, orange, red, violet, purple, green and blue (Guilford & Smith, 1959:490).
E7	Colours should be associated with concepts such as (Wexner, 1954:433; Adams & Osgood, 1973:145): 1. Red = exciting, stimulating, strong, active 2. Blue = secure, comfortable, tender, soothing 3. Orange = disturbing, distressed, upset 4. Black = powerful, strong, masterful, bad
E8	Colours that are less bright and more saturated should be incorporated as they are more emotionally arousing than others (Valdez & Mehrabian, 1994:398).
E9	Large, still versions of images should be used as they are more emotionally arousing than small, still versions, small, motion versions and even large, motion versions of an image (Detenber & Reeves, 1996:77).
E10	Sounds should be used to supply further affective information to and elicit emotions from readers (Juslin & Västfjäll, 2008:560).
E11	Visual imperfections should be compensated for through the use of sound (Reeves & Nass, 1996; Tajadura-Jiménez & Västfjäll, 2008:69).
E12	The designer, artist and author of a digital graphic novel portraying emotional social phenomena should strive to make a reader experience emotion salient enough for the reader to confide the emotional experience to others (Rimé <i>et al.</i> , 1998:148).
E13	Frames should be used to generate emotional involvement from the reader and portray a visual perspective of the emotional climate within which a certain action occurs through the variation of shape or treatment of frames (Eisner, 1990:46).
E14	Pictures used within a digital graphic novel portraying emotional social phenomena should evoke an emotional response (McCloud, 2011:118).
E15	The reader should be able to recognise both the meaning and emotional impact of the selected image used within a digital graphic novel portraying emotional social phenomena (Eisner, 1990:13).
E16	The inner life of a character contains a character's life history which should help the reader emotionally connect with the character while also providing a platform from which differences in life experiences of the character and other characters can elicit stories worth being told (McCloud, 2011:65).

E17	Facial expressions in comics are important in order for the comic artist to portray the emotions of the characters to the readers as well as to provoke emotions in the readers themselves (McCloud, 2011:81).
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6.8 Summary

The all-encompassing goal of human-computer interaction can be defined as the development of products that elicit positive emotional responses from their users (Rogers *et al.*, 2011:127). These responses include a feeling of comfort and pleasure from using the product. Human-computer interaction designers concern themselves with a product's ability to elicit the intended emotional responses from the user, such as the motivation of users to be creative or social (Rogers *et al.*, 2011:127).

Emotions and emotional social phenomena have been discussed in Section 6.2 of this study. The correlation between emotions and other subjects such as sight, sound, HCI and digital graphic novels were explored in Section 6.3, 6.4, 6.5 and 6.6 respectively. The relationships discovered in the aforementioned sections were used to enrich guidelines for creating digital graphic novels portraying emotional social phenomena using critical systems heuristics and HCI principles, which are presented in Section 6.7. Within this study, the researcher will attempt to use the aforementioned guidelines in order to elicit emotions from the user that correlate with the content discussed within a digital graphic novel portraying an emotional social phenomenon.

The next chapter will report on the *Diagnosis* phase of the study. As seen in Figure 6.1, this phase is the first phase of the action research cycle and will assist the researcher in identifying which stories told by the ex-political prisoners should be included in the digital graphic novel.

GUIDELINES TO DESIGN DIGITAL GRAPHIC NOVELS PORTRAYING EMOTIONAL SOCIAL PHENOMENA USING CRITICAL SYSTEMS HEURISTICS AND HCI PRINCIPLES

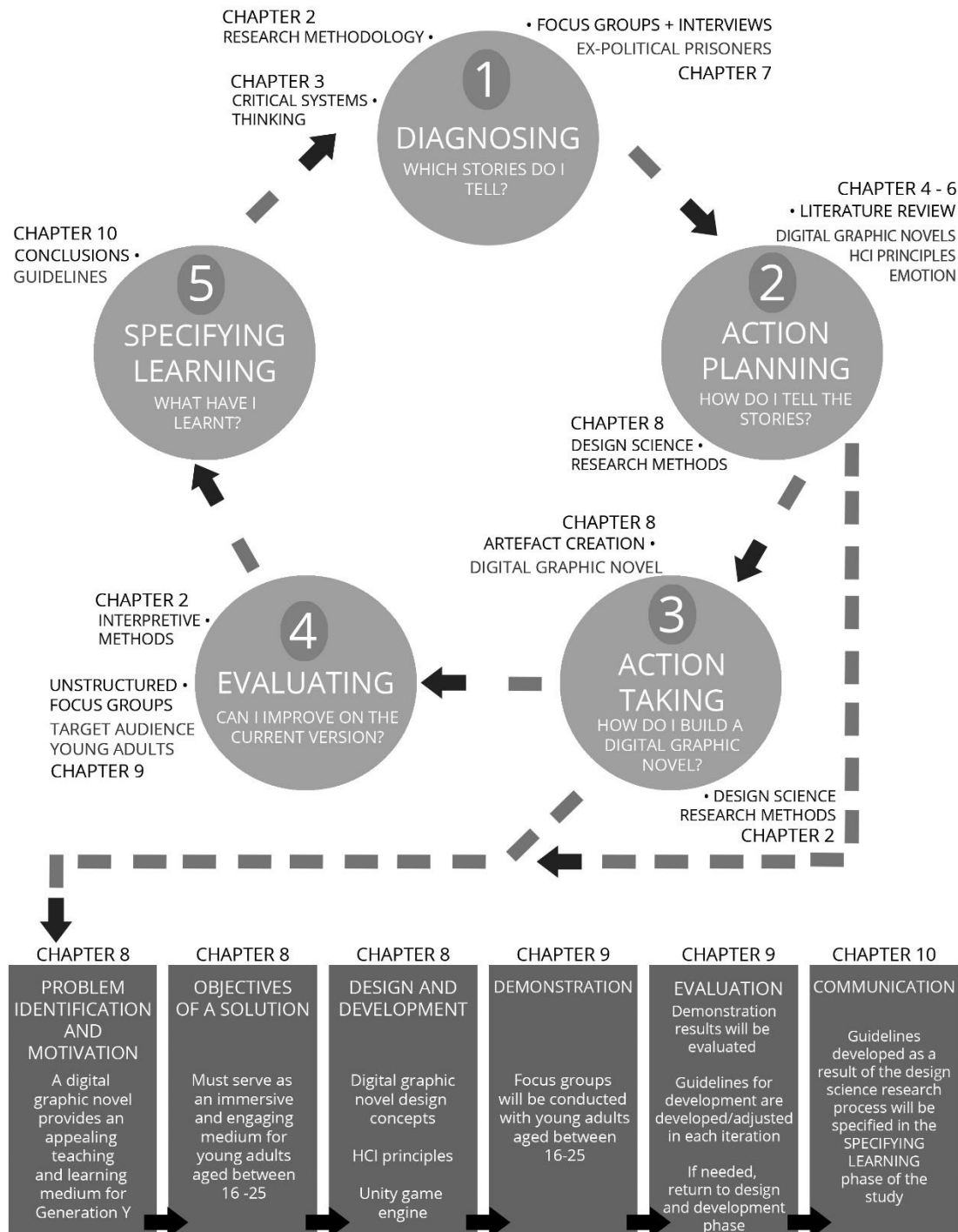


Figure 6.1: An adaptation of the action research cycle (Baskerville, 1999:14) and the design science research process (Peppers et al., 2006:93) to represent the research structure of this study.