Technical Report

Usability and Accessibility Evaluation of the Digital Doorway

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Abstract

This report is about the usability and accessibility evaluation conducted on the Digital Doorway – a non standard computer system developed by researchers at the Meraka Institute of the Council for Scientific and Industrial Research (CSIR) in collaboration with the Department of Science and Technology (DST). The project aims to narrow the digital divide by making computer systems available to users in underprivileged communities in South Africa. Since its inception, the project has mainly concentrated on providing physical access to computers with no formal usability evaluation.

This study aims to establish the ways in which the standard usability evaluation methods and accessibility evaluation techniques can be used in the evaluation of a selection of interfaces and applications installed on the Digital Doorway. Accessibility evaluation was limited to direct accessibility support built into the Digital Doorway since the system does not currently support the use of assistive devices, such as screen readers for visually impaired users.

It involved two cycles of design research. In the first cycle, an investigation of available methods for evaluating the usability and accessibility of interactive systems was done to determine the appropriate methods for the Digital Doorway. Based on the literature investigation and practical constraints imposed by the Digital Doorway, the heuristic evaluation method was selected as the primary evaluation method. Field evaluation through direct user observations and questionnaires were employed as secondary methods.

To derive maximum benefit from the heuristic evaluation, application-specific heuristics were developed during a second (inner) cycle of design research where a literature investigation of existing usability and accessibility principles and guidelines for the design of interactive systems was done. In addition, guidelines for the design of computer-based educational games were also examined.

Findings from the evaluation revealed various usability and direct accessibility problems, indicating the need for the development of in-house usability standards to guide developers. Many of the identified problems could have serious implications for successful interactions with the Digital Doorway.
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1 INTRODUCTION

This document reports on the usability and accessibility evaluation of the Digital Doorway (DD) and the findings thereof. The evaluation was conducted on a selection of interfaces and applications developed in-house for the DD, namely:

1. The login screen (441.1).
2. The electronic form for new user registration (441.1).
3. The main desktop (441.1).
5. OpenSpell (1.0).
6. Themba’s Journey (1.0).

The DD is a non-standard¹, non-web based computer system developed as a joint initiative between the South African government’s Department of Science and Technology (DST) and Meraka Institute of the Council for Scientific and Industrial Research (CSIR) [Gush, De Villiers, Smith and Cambridge, 2010].

The system is housed in a rugged, custom-designed kiosk with terminals that can be accessed simultaneously by multiple users. Each of the terminals has metal keyboard with a reinforced touchpad for input. The rugged housing and metal keyboard help to minimize vandalism. Software applications in the DD run on the Ubuntu Linux operating system, with applications and content pre-loaded [Gush et al., 2010].

The DD project aims to narrow the digital divide by making computer systems available to users in underprivileged communities in South Africa and promote computer literacy using the independent discovery and unassisted learning methods [Gush et al., 2010].

The first DD was installed at the rural community of Cwili in the Eastern Cape Province in 2002 and, to date, a total of 206 DDs have been deployed around South Africa. Since its early days, there has been no usability and accessibility evaluation of the software installed on the system. Given the important role that usability has to

¹ Non-standard in this context means systems that do not display standard operating system interfaces or use standard equipment.
play in the effort to narrow the digital divide [bridges.org, n.d; Nielsen, 2006; Wilson, 2006], conducting a usability evaluation of the software installed on the DD is therefore relevant and important.

Although the DD project has focused on hardware development, the hardware does not currently support the use of assistive devices, such as screen readers for visually impaired users. However, the global trend is the enabling of electronic information to people with varying abilities. This is to ensure compliance with regulatory/legal requirements, increase the market share for products and services and for ethical considerations, among others factors [Henry, 2002]. While the DD cannot be evaluated for its accessibility to disabled users requiring access through the use of assistive devices, its level of direct accessibility support can be assessed.

Direct accessibility refers to the built-in redundancies in applications which enable as many people as possible to use the application without system modifications [Vanderheiden, 1994]. Direct accessibility support provides benefits not only to users with disabilities, but also to those without. In addition, where the environment of use constrains the use of the system (*situational limitation*) [Henry, 2002], direct accessibility support will enhance general usability. It is thus important to consider support for direct accessibility when evaluating the DD.

The results from this summative evaluation of the DD will assist the project team in improving future versions of the DD so as to achieve its main objective of narrowing the digital divide.

2 THEORETICAL BACKGROUND

2.1 Usability and Usability Evaluation Methods

Usability is defined as “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” [International Organization for Standardization, 1998]. Incorporating usability concerns early in development lifecycle will result in applications that support users in the accomplishment of their goals and tasks [Dix, Finlay, Abowd and Beale, 2004].

Interactive systems should be evaluated for their usability, this should start early in the design phase and continue throughout the development life cycle. The process
should also be iterative, with evaluation results being fed back to the next iteration [Dix et al., 2004; Preece, Rogers and Sharp, 2007].

Evaluation is “the process of systematically collecting data that informs us about what it is like for a particular user or group of users to use a product for a particular task in a certain type of environment” [Preece, Rogers and Sharp, 2002].

Evaluation is typically done to (i) determine the ease of use of the systems’ functionalities, (ii) assess the user interaction experience, and (iii) to identify any specific problem in the system [Dix et al., 2004].

Evaluation can be formative or summative. Formative evaluations are conducted during development to guide design decisions while a summative evaluation is typically carried out on a finished or existing application. This type of evaluation is usually more focused on specific issues such as usability [Kotzé and Johnson, 2004; Preece et al., 2007].

2.1.1 Usability Evaluation Methods (UEMs)

Usability evaluations methods can be grouped according to whether expert evaluators or user participants are involved in the evaluation process. Evaluation methods by expert evaluators are heuristic evaluation, cognitive walkthroughs and model-based evaluation. These types of UEMs can be used in both formative and summative evaluations. Evaluations requiring user participation are questionnaires, interviews, field observations and usability testing [Dix et al., 2004; Preece et al., 2007].

2.1.1.1 Heuristic Evaluation

Heuristic evaluation is a method where expert evaluators independently assess the compliance of a given interface with specific set of evaluation guidelines [Dix et al., 2004; Nielsen, 1994; Preece et al., 2007]. Heuristic evaluation should involve at least three evaluators, but an optimal result can be achieved by having five evaluators assess the system [Nielsen, 1994].

Heuristic evaluation method is generally accepted as an easy and cost-effective method for evaluating the usability of interactive systems’ interfaces. However, the classic sets of heuristics developed by Nielsen and others are sometimes too general, necessitating the development of application-specific heuristics to be of value.
Examples of such application-specific heuristics are web usability heuristics [Preece et al., 2007] and learning with software heuristics by Squires and Preece [1999].

During the evaluation procedure, a record is made of which interface element violates which heuristic(s). The recording of usability problems can be done by the evaluator or a scribe. Following evaluation by all the experts, the results of all identified problems are collated and the severity rating for each problem calculated.

2.1.1.2 Cognitive Walkthrough

Cognitive walkthrough is an inspection method that is based on cognitive science theory where experts step through a set of tasks. Cognitive walkthrough aims to assess the learnability of systems where users learn to use the system by exploration rather than reading through user manuals [Cockton, Lavery and Woolrych, 2008; Dix et al., 2004; Preece et al., 2007; Wharton, Braffort, Jeffries and Franzke, 1992]. It is a flexible method that can be used for formative and summative evaluation before user testing [Wharton et al., 1992], but it does not address other measures of usability like the application efficiency. The method assumes that the evaluator possesses cognitive theory skills [Wharton et al., 1992].

2.1.1.3 Model-Based Evaluation

Model-based evaluation methods are used by experts to predict user performance in systems with limited functionalities using formulas or simulations [Kieras, 2008; Preece et al., 2007]. Models are typically used during the design stage to evaluate different design alternatives for their efficacy, although they can be used at user-manual design stage to describe what the user needs to do in order to achieve a specific goal. The two well-known model-based methods are the goals, operators, methods and selection rules (GOMS) and the Keystroke-level models [Dix et al., 2004; Preece et al., 2007].

GOMS model is used to predict an expert user’s performance in computer-based task in terms of the user’s goals and selection of methods required to achieve them [Dix et al., 2004; Kieras, 2008; Preece et al., 2007] while the keystroke-level model is a quantitative analysis method used to predict the time it will take an expert user to complete routine tasks on an interactive computer system [Card, Moran and Newell, 1980].
2.1.1.4 Interviews

Interviews can be used to evaluate whether an interface or a fully implemented system meet users’ requirements. Interviews can be structured, unstructured, or semi-structured [Dix et al., 2004; Preece et al., 2007].

In a structured interview, series of pre-determined questions and available options are read to the interviewee, with the interviewer ticking off the participant’s response from the list. Unstructured interviews entail the evaluator posing open-ended questions which the interviewee can answer as fully or as briefly as he/she wants. The flexible nature of unstructured interviews enable variation in the nature of questions posed based on the interviewee’s response. Semi-structured interviews combine features of both structured and unstructured interviews [Dix et al., 2004; Preece et al., 2007].

Interviews can be highly subjective as they are typically used to measure users’ opinion. While it may be impossible to avoid participant subjectivity, it is essential to be aware of them.

2.1.1.5 Questionnaires

Questionnaires are similar to interviews in that questions can be closed or open, but not as flexible as interviews because questions are fixed and further probing is impossible. In addition, the evaluator is not present when study participants complete the questionnaires, making it impossible for participants to clarify questions they may find confusing [Dix et al., 2004; Preece et al., 2007].

The potential for generating flawed data is high when using questionnaire as the sole evaluation method. Hence it may not adequately reflect the actual usability of the application [Nielsen, 1993]. This is why evaluation methods are typically combined to triangulate data [Nielsen, 1993; Preece et al., 2007].

2.1.1.6 Observations

This is an evaluation method where real users are observed while interacting with the target application. The method can be used early in the development process as part of task analysis (formative evaluation) or to evaluate the usability of a fully functional system following deployment (summative evaluation) [Dix et al., 2004; Lindgaard, 1994; Nielsen, 1993; Preece et al., 2007].
Users can be observed directly in the field or in a controlled environment and indirectly either by having users make note of important aspects of their interaction with a given application such as time spent on tasks or components they found difficult to use. Another method of indirect observation is through interaction logging [Preece et al., 2007].

Direct field observation can be done with the evaluator either assuming the role of a participant observer or a passive observer. Direct observation in the field can reveal details that are difficult to obtain using other evaluation methods, as it enables the researcher to see the context of use of the application [Preece et al., 2007].

Direct observation in a controlled environment is done as part of formal usability testing where evaluators observe users while carrying out specific tasks through a one-way mirror or on computer monitor [Preece et al., 2007].

2.1.1.7 Usability Testing

Usability testing (UT) is an evaluation method where the performance of typical users is measured as they carry out real, pre-defined tasks using the target application. The aim of UT is to test the usability of the system, not the users’ ability. UT is expensive, requiring sophisticated usability laboratory equipped with monitoring cameras and equipment [Barnum, 2002; Preece et al., 2007; Rubin, 1994]. To be effective, UT is typically combined with think-aloud, where users are encouraged to verbalize their thoughts and the reasoning behind their actions as they carry out the tasks [Barnum, 2002].

A summary of the UEMs discussed above, together with the benefits and limitations of each method, is provided in Table 2.1.
Table 2.1: Summary of usability evaluation methods

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<th>Technique</th>
<th>Description</th>
<th>Advantages</th>
<th>Limitations</th>
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<td>Heuristic evaluation</td>
<td>Experts independently assess the interface using a set of evaluation criteria.</td>
<td>- Flexible, can be used for formative or summative evaluation.</td>
<td>- Sometimes require the development of application-specific evaluation criteria.</td>
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<td>- Ability to provide quick feedback to designers.</td>
<td>- Requires multiple evaluators.</td>
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<td></td>
<td>- Can reveal large numbers of potential usability problems.</td>
<td>- Some problems that may affect real users may be overlooked.</td>
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<td>Cognitive walkthrough</td>
<td>Experts step through a set of tasks to assess learnability of the system.</td>
<td>- Flexible, can be used in formative and summative evaluation.</td>
<td>- Setting up of representative tasks can be tedious.</td>
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<td></td>
<td></td>
<td></td>
<td>- Other measures of usability are not addressed.</td>
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<td>Model-based evaluation</td>
<td>Experts attempt to predict user performance using formulas or simulations.</td>
<td>- Suitable for formative evaluation.</td>
<td>- Assumes the user to be an expert and do not cater for error-free execution of tasks</td>
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<td>- Can be used to guide the decision between competing design alternatives.</td>
<td>- Focus is on the procedural aspect of interface design.</td>
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<td></td>
<td></td>
<td></td>
<td>- It does not address other aspects of usability, such as the readability of interface text.</td>
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<td>Direct field observation</td>
<td>Users are watched while carrying out tasks in a natural context of use.</td>
<td>- Natural context is retained.</td>
<td>- High level of disruptions.</td>
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<td></td>
<td></td>
<td>- Ability to reveal specific usability problems which may impact user tasks.</td>
<td>- Participants may alter their behaviour.</td>
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<tr>
<td>Interviews</td>
<td>Used to obtain user requirements for a new system and measure extent to which a functional system meet their expectations.</td>
<td>- Flexible, can be used for formative or summative evaluation</td>
<td>- Participants’ subjectivity.</td>
</tr>
<tr>
<td>Questionnaires</td>
<td>Used to obtain user requirements for a new system and measure extent to which a functional system meet their expectations.</td>
<td>- Large number of respondents can be reached in short time.</td>
<td>- Participants’ subjectivity.</td>
</tr>
<tr>
<td>Usability testing</td>
<td>Real users are observed while carrying out pre-specified tasks in a controlled environment.</td>
<td>- Ability to reveal specific usability problems which may impact user tasks.</td>
<td>- Expensive, requires sophisticated equipment.</td>
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<td></td>
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<td>- Some participants may find thinking aloud unnatural.</td>
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2.2 Interactive Systems’ Accessibility

Concerns for accessible interactive systems are increasing. Reasons for this include the explosive growth of the World Wide Web (WWW) and the Internet as well as regulatory requires for developers to make electronic information accessible to people with disabilities [Iwarsson and Ståhl, 2003; Rogoff, 2001].

According to Henry [2007], accessibility is “the design of applications that are perceivable, operable and understandable for people with a wide range of abilities”.
Consideration for accessibility issues ensure that barriers, which may prevent people with disabilities from taking part in life activities, including the use of services, products and access to information are removed [Bergman and Johnson, 1995].

Accessibility can be supported in one of two ways:

(i) *Direct accessibility* – where redundancies are built into the application so that as many people as possible can access them without system modifications or the use of special adaptive hardware or software. An example of direct accessibility support is the provision of audio feedback in addition to text-based feedback.

(ii) *Indirect accessibility* – where access is supported through compatibility with add-on assistive devices like a screen [Vanderheiden, 1994].

Usability and accessibility should be seen as complementary design concepts that are not subordinate to one another. Adherence to usability and accessibility principles can only lead to good design. In order for an application to be usable, it must be accessible. A system that provides information through sound alone cannot be used by a user with hearing impairment. Likewise, compliance with technical accessibility requirements alone will not make an application usable. A design that meets the technical specification for the provision of alternative text for graphic elements on an interface may not be usable if the alternative text is not meaningful to the context of use [Henry, 2002].

### 2.2.1 Disability Categories: Implications for Design of Interactive Systems

Users of interactive computer systems can be affected differently depending on the type in disability they have. Disability can be visual, auditory, physical, or cognitive.

#### 2.2.1.1 Visual Disabilities

The two types of visual impairments affecting user interaction with computer systems are colour blindness and blindness.

People with colour blindness have difficulty in distinguishing between different colours, especially the red and green colours [Dix et al., 2004; Rigden, 1999]. The implication of this for designers is that they should avoid the exclusive use of colour to present important information and cueing. Furthermore, background and foreground colours should be have high contrast against one another.
For blind users, the move towards graphical user interfaces (GUIs) has created accessibility barriers due to limitations of screen readers and Braille outputs in interpreting graphical interface elements [Dix et al., 2004].

Blind users typically encounter problems when interacting with web-based applications due to:

- Lack of or incorrect use of meaningful alternative text for graphical elements.
- Navigational elements which are inaccessible to assistive technologies.
- Excessive strain on cognitive resources due to the large amount of information which must be converted to speech [Evers and Hillen, 2007; Kennel, Perrochon and Darvishi, 1996].

Access to electronic information by blind users can be supported by providing meaningful and contextual alternative texts for all graphical elements and ensuring compatibility with assistive technologies such as screen readers [Dix et al., 2004; Henry, 2002].

### 2.2.1.2 Auditory Disabilities

Auditory impairments range from total deafness to mild to moderate hearing difficulties. When compared to users with visual impairment, computer-based applications have benefited users with hearing impairments to a greater extent due to the high visual mode of information presentation. However, the trend towards the use of multi-media presentations with auditory narrations and the increase in the use of sound in interactive systems can result in accessibility problems for users who are deaf or hard of hearing [Dix et al., 2004; Hanson, 2008].

The implication of this for designers is that when information is presented through multiple modes, such as text, sound, animations, and video, the information presented in each of these channels should not be materially different from each other, otherwise it becomes inaccessible to the hearing impaired user.

Support for the hearing impaired user can be provided through the use of captioning and sign language interface.
2.2.1.3 Physical Impairments

Physical impairments affect users’ ability to physically interact with computer systems. The tendency towards the design of smaller and smaller computer devices can result in accessibility barrier to the physically impaired. Such devices typically require some degree of accuracy and precision during interaction, the kind of precision that is lacking in users with physical impairments.

For some users with physical impairments who can still use their hands, modifications to the standard keyboard in the form of accelerators is all that is required to provide access. For others, the use of head-controlled input devices, eye-controlled device, speech-based interactions or special on-screen keyboard may be required.

2.2.1.4 Cognitive Impairments

Cognitive impairment is the general term used to describe a variety of conditions including those affecting thinking, memory, learning and perception [Vanderheiden, 1994]. The condition could occur as a result of birth defects or congenital malformations, following injuries, stroke, and the effect of aging.

It is far more challenging to design applications to support users with cognitive impairments due to the difficulty in understanding the problem area to be addressed. Despite this challenge, attention to basic design principles can go a long way in enhancing the interaction experience for these users.

Usability principles, such as, the use of simple, unambiguous terms, consistency in the layout of interface elements and the use of multiple modes for information presentation will make access to electronic information more effective for these users.

2.2.2 Accessibility Evaluation Methods

Accessibility evaluation can be incorporated into a number of the standard usability evaluation techniques discussed in section 2.1.1. For example, heuristic evaluation can include evaluation heuristics focusing on accessibility issues, while participants in usability testing can include users with disabilities. This section provides a brief overview of the accessibility evaluation methods proposed by Henry [2007] and the Web accessibility methodology of Greeff and Kotzé [Greeff and Kotzé, 2009].
2.2.2.1 Henry’s Methods for Evaluating Accessibility

1. **Standards Review**: An accessibility evaluation method where the target application or system is assessed for conformance to specific design standards. The standards can be internally developed within an organization or externally specified by a national or international organization, for example the WCAG 1.0 [1999]. Accessibility standards review is more thorough when it concerns conformance to legal requirements [Henry, 2007].

2. **Heuristic Evaluation**: Evaluation heuristics address accessibility principles or guidelines [Henry, 2007].

3. **Design Walkthroughs**: The evaluator mimics the activity of a representative user while a design team member guides him/her through specific tasks using the design or prototype through the use of personas with disabilities and scenarios requiring the use of adaptive technologies to complete a task.

4. **Screening techniques**: Screening is an accessibility evaluation method used early in design to reveal potential accessibility problems. It involves the evaluator interacting with the design with one or more physical or sensory abilities removed or modified. For example, the evaluator might put on a thick glove in order to reduce hand dexterity or wear a low vision glass to limit vision. It may also involve the use of adaptive strategies or assistive devices by the evaluator.

5. **Usability testing**: Usability testing, as discussed in section 2.1.1, can be used to evaluate an application’s accessibility with some modification by including users with disabilities as part of the test participants. The number and characteristics of participants to be included in the evaluation will vary, depending on what category of disabled user groups the application is targeted at.

6. **Use of accessibility evaluation tools**: Automatic software tools, for example, Total Validator [2009], are typically used to evaluate Web pages and certain elements of a software for their compliance with accessibility guidelines and standards (for example the WCAG 1.0 and Section 508). While these can tools can automate initial evaluation process, human evaluation, such as heuristic evaluation, is still necessary due to the limitations of these tools. A software tool, for example, can indicate a missing alt text for an image but it cannot determine whether an existing alt text conveys the same information as the image it represents [Henry, 2007].
2.2.2.2 Greeff and Kotzé’s Accessibility Evaluation Methodology

Greeff and Kotzé [2009] propose a lightweight methodology for evaluating the accessibility of interactive systems, including Web-based applications. The methodology involves three iterative phases [Greeff and Kotzé, 2009]:

1. **Initial accessibility evaluation**: The first phase of evaluation is aimed at discovering accessibility problems inherent in the target application before the involvement of users in the evaluation process. It entails the use of automatic software tools to evaluate whether the Web site conforms to specific accessibility guidelines, the readability of text on the site and colour contrasts. After the initial automated evaluation, identified accessibility problems are corrected. This is then followed by another iteration of the automated evaluation procedure before proceeding to the second phase.

2. **Testing with real users**: Evaluation with automatic software tools has limitations. To ensure accessibility and user acceptance by the target user group, the initial automatic assessment with software tools is followed with user testing, where users from different disability categories are involved in the evaluation.

3. **Development of in-house context-specific guidelines**: The third phase of the methodology involves the development of in-house, context-specific guidelines that can be used by non-expert developers to guide future enhancement and development efforts so that similar design errors are not repeated. These guidelines are influenced by the lessons learnt from the first and second phases of evaluation.

2.2.3 Usability and the Digital Divide

One of the aims of the DD project is to narrow digital divide by making computer systems available to users in underprivileged communities in South Africa and promote computer literacy using the self-discovery and unassisted learning methods [Gush et al., 2010].

Digital divide is a multidimensional phenomenon involving disparities in access, distribution, and use of ICTs between two or more populations [Wilson, 2006]. It affects different age and gender groups, communities, races and regions of the world [Camacho, 2005] and can also be seen among different population groups within the same nation.
There are several factors contributing to digital divide, among them financial constraints, lack of adequate skills and complexities of the interfaces of ICT devices, i.e. their usability. While concerns for interface usability are essential for all users, it is even more the case when the target user groups are inexperienced and underserved. These are the users groups where the gap of digital divide is widest. Inappropriate design decisions by developers could negatively impact on these user groups’ ability to take advantage of the potential social and economic benefits of new technologies.

Where the target user population do not possess the basic ICT skills to access the software, application interfaces should be particularly supportive and should facilitate learning by exploration. It should be tolerant of user error and designers should make every effort to hold the user’s attention. An intuitive, easy to use interface will enable the underprivileged to take advantage of the economic and social benefits offered by new technologies. Efforts to narrow digital divide should not be concentrated on providing physical access to technologies, the usability of the interfaces of these devices is as important as the provision of the devices themselves.

3 RESEARCH PROCESS

3.1 Research Design

The study involved two cycles of the design research paradigm. Design research is the analysis of the use and performance of designed artefacts, for example a computer system’s interface, with the aim of better understanding and improving the artefact [Vaishnavi and Kuechler, 2004]. It fits what Simon [1996] (as cited by Vaishnavi and Kuechler [2004]) termed as science of the artificial, which are man-made objects designed to achieve specific objectives. Design research generally has five phases, namely awareness of problem, suggestion, development, evaluation, and conclusion [Vaishnavi and Kuechler, 2004].

The first cycle encompasses the whole research process while a second, inner cycle involves the development of the heuristics for evaluating the DD. Sections 3.1.1 and 3.1.2 discuss the phases of the two design research cycles.
3.1.1 Outer Cycle of Design Research

1. *Awareness of problem:* This is the first phase of the design research process. The problem involved an interactive computer system had never been evaluated for the usability and accessibility of the applications installed on it since its inception in 2002. Without evaluation, it is difficult to determine whether users will be able to use a given application to complete real tasks.

2. *Suggestions:* This phase involved literature investigation of the various usability and accessibility evaluation techniques. The choice of evaluation methods is typically influenced by eight factors. The relevant factors that affected the selection of evaluation methods for the DD are the following:

   o *The stage at which evaluation is done:* The DD has been a fully operational system since the first deployment in 2002. This study is thus a typical summative evaluation. The heuristic evaluation method is a relatively easy and effective method that is suitable for both formative and summative evaluation, provided appropriate evaluation heuristics are used in the evaluation. In addition, the heuristic evaluation method is one of the techniques recommended by Henry [2007] for evaluating interactive systems’ accessibility. An assessment of the level of direct accessibility support in the DD can be easily done using this method since users with disabilities cannot be included as study participants.

   o *Style of evaluation:* Evaluation can be done in controlled environments such as a usability laboratory or a natural environment of system use. Although a well-equipped usability laboratory is available for students’ use at UNISA, practical considerations made the use of controlled usability testing infeasible (since the DD could not be physically moved to the usability laboratory). Furthermore, the observation and logging software in the laboratory is only compatible with applications running on the Microsoft Windows operating system, while applications on the DD run on the Ubuntu Linux operating system.

   Because the use of evaluation methods involving typical users can reveal usability problems that may be overlooked in heuristic evaluation, field usability evaluation through the direct observation method and questionnaires at one of the centres where the DD is deployed is selected as secondary evaluation methods.
Resource Requirements: The relative ease with which I could get expert usability/accessibility evaluators for this study made the heuristic evaluation method appealing. In the field usability evaluation, the main consideration involved the decision on the appropriate time to conduct evaluation to limit disruptions to learning activities as much as possible. Because of this, evaluation sessions took place in the afternoons after the official school hours.

3. Development: This is an artefact creation phase. The artefact in this study was not a physical object. Rather, it involved the development of appropriate evaluation heuristics for the DD. This phase triggered the second, inner design research cycle, discussed in section 3.1.2. The result of this phase was the set of multi-category evaluation heuristics that could be used to evaluate the applications installed on the DD.

4. Evaluation: This is the phase where the DD was evaluated using the multi-category evaluation heuristics. The primary method for evaluating the DD was therefore a heuristic evaluation method by usability and/or accessibility experts. The heuristic evaluation was complemented with a field usability evaluation at a local school. In addition, a selection of heuristics, which emerged from the development phase, was converted into questionnaires. The questionnaires were used by participants in the field usability evaluation to assess the usability of the DD.

5. Conclusion: This is the final phase of the design research paradigm where the research report is produced and an oral presentation of the findings from the study to the relevant stakeholders at the Meraka Institute.

3.1.2 Inner Cycle of Design Research

The inner cycle of the design research was triggered during the development phase of the outer cycle. It entailed the development of a set of multi-category heuristics for evaluating the DD.

1. Awareness of problem: During the suggestion phase of the outer cycle of the design research process, the heuristic evaluation method was selected as an appropriate method for assessing the usability and direct accessibility support provided in the DD. However, the value of the heuristic evaluation method lies in using appropriate heuristics for the specific system to be evaluated. The usability design principles by authors, such as Dix et al. [2004] and Nielsen [1994], focus
on interface usability and cannot be used to evaluate accessibility. Likewise, the usability of educational game applications may not be adequately covered by general usability guidelines. This makes it crucial to develop an integrated set of evaluation heuristics that address general usability, direct accessibility and educational game usability in the interfaces and applications evaluated.

2. **Suggestions:** This phase involved an extensive literature investigation of existing principles and guidelines for the design of usable and accessible interactive systems, including those for the design of computer-based educational games. The principles and guidelines examined were (i) the usability principles proposed Dix et al. [2004] (ii) Gelderblom’s [2008] guidelines for the design of children’s technology (iii) Mayhew’s guidelines for the design of form-fill interfaces [1992] (iv) Nielsen’s heuristics [1994] (v) the usability principles by Preece et al. [2007] (vi) the design principles proposed by Norman [2001], and (vii) Shneiderman’s [1998] golden rules for interface design.

To derive direct accessibility-specific heuristics, the following guidelines were reviewed: (i) the seven principal of universal design [Story, Mueller and Mace, 1998] (ii) WCAG 1.0 [1999] (iii) the United States’ standards for electronic information accessibility (Section 508) [2000], and (iv) the IBM software accessibility checklists [2009].

To address educational game usability, educational game design guidelines proposed by Alessi and Trollip [2001], Malone [1980; Malone, 1981] Shelley [2001] and Desurvire, Caplan and Toth [2004] were reviewed.

3. **Development:** This involved the development of the evaluation heuristics, based on the principles and guidelines examined in the suggestion phase. The principles and guidelines were not equally applicable to the DD context. For example, the principles of multithreading and task migratability by Dix et al. [2004], were found not to be essential to the context of use of the DD. Likewise, I also found that the WCAG 1.0 is mainly aimed at Web-based systems. However, a few of these were relevant to the DD context. For example, guidelines relating to the use of colours and multimodal information presentation were found to be useful in the evaluation of the direct accessibility support provided in the DD. The result of this phase was an initial set of evaluation heuristics.

4. **Evaluation:** The initial set of evaluation heuristics were tested, where I conducted a heuristic evaluation on the selected interfaces and applications on the DD to
assess the level of coverage. Modifications to the heuristics were based on the results from this initial evaluation. Thereafter, an HCI expert, who had previous experience in usability and accessibility issues, used the modified heuristics to evaluate the DD. This expert was not included in the team of five experts who participated in the formal heuristic evaluation of the DD (this expert was not included in the team of five experts who participated in the formal heuristic evaluation of the DD). Further modifications were then made to the evaluation heuristics based on suggestions by the expert. The output of this phase was the set of multi-category heuristics that was used to evaluate the DD.

5. Conclusion: This phase marked the end of the inner cycle of the design research process and the resumption of the evaluation phase of the outer cycle.

3.2 Heuristic Evaluation Process

A team of five experts, whose profiles are shown in Table 3.1, independently evaluated the DD using the developed multi-category heuristics. For logistical reasons, evaluators had to come physically to the DD laboratory located at the CSIR for the evaluation. The five evaluation sessions were conducted over a period of three months. Three of the experts have experience in usability evaluations while the other two have expertise in usability and accessibility evaluations.

<table>
<thead>
<tr>
<th>Evaluator 1</th>
<th>Qualification</th>
<th>Position/Job Title</th>
<th>Duties/Roles at Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluator 2</td>
<td>MSc, Certified Usability Analyst</td>
<td>Usability manager and Researcher</td>
<td>Usability analyst/consultant; Usability and Eye tracking research</td>
</tr>
<tr>
<td>Evaluator 3</td>
<td>MSc (Computer Science)</td>
<td>Researcher</td>
<td>Research in the field of optimization; Organization and conduct of usability and accessibility evaluations</td>
</tr>
<tr>
<td>Evaluator 4</td>
<td>PhD, MSc, Med</td>
<td>Full Professor</td>
<td>Tuition; Postgraduate supervision; Research; Management and Leadership</td>
</tr>
<tr>
<td>Evaluator 5</td>
<td>M(Eng): Technology Management</td>
<td>Researcher</td>
<td>Research in the field of voice user interface</td>
</tr>
</tbody>
</table>

Following a written confirmation of their willingness to voluntarily participate in the heuristic evaluation of the DD, each of the evaluators was sent a copy of evaluation criteria (Appendix A) and evaluation information document (Appendix B) well in advance to allow them time to familiarize themselves with the documents. The evaluators also signed informed consent forms.
The nature of the system being evaluated meant that evaluators had to stand in front of the DD for two hours (one evaluator spent nearly two hours twenty minutes) to open, interact with and evaluate the interfaces and applications selected for evaluation, with short breaks in-between applications. This condition was not conducive for evaluators to evaluate and make notes of their findings simultaneously. One possible way to ease the evaluation tasks for the evaluators was for me to offer to act as a scribe during the sessions. All five evaluators accepted my offer to act as scribes.

At the start of each evaluation session, the heuristics were reviewed with the evaluators. Each evaluator then traversed the interfaces and applications one after the other by performing typical user tasks. Usability/accessibility problems relating to the specific interface or application were described to me by the evaluator. After the session, an evaluation report was then compiled and mailed to the relevant evaluator the day after the evaluation. The report was then verified the evaluator to ascertain whether it was a true reflection of the evaluation, rather than the evaluator compiling a full report from scratch. In some cases, the verification process resulted in modifications to the report by evaluators. This approach enabled the judicious use of evaluators’ time and focused their attention on the evaluation task.

3.3 Field Usability Evaluation Process

Designers typically make assumptions about potential users [Gardner-Bonneau, 2010]. Evaluation with real users enables evaluators to assess the extent to which those assumptions are valid. Evaluation with real users in an environment where the context is retained enabled me to assess usability and/or accessibility problems in the DD from users’ perspective. The following subsections describe the field usability evaluation on the DD.

3.3.1 Evaluation Environment

The DD was evaluated in at a local high school with the DD installed in an open space along a corridor. This is to enable unrestricted access to the system by users. A tarpaulin hanging from a wall provides some shading from the reflection of the sun. At this center, children from the surrounding homes also have access to the DD after the official closing hour of the school.
Prior to conducting the evaluation, formal approval was obtained from the school principal. Parents/guardians of participants also signed informed consent forms. Samples of approval from the school principal and consent form for parents/guardians are provided in Appendices C and D.

Nine learners participated in the main field study which was preceded by a pilot study with three participants. Six of these participants were given pre-defined tasks to complete while the other three participants were allowed to use the system as they wished. Of the six participants given pre-defined task, two participants each used one of the educational games. These participants were also required to register a new user account before accessing the applications unless they had a valid account. The other three participants could access the system as a guest if they wished.

Participants with disabilities were not included in the evaluation because the DD does not support the use of assistive devices such as a screen reader; hence it will be pointless to include a blind user, for example. The profile of the participants, together with the applications they used is provided in Table 3.2.

As shown in Table 3.2, there were six male and three female participants. The age of the participants ranged from thirteen to eighteen. Three participants were in grade eight, one in grade ten and two in grade eleven. The grades of three participants are unknown as their questionnaires were not returned.

<table>
<thead>
<tr>
<th>Participants</th>
<th>Age</th>
<th>Gender</th>
<th>Grade</th>
<th>Application used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>17</td>
<td>F</td>
<td>11</td>
<td>OpenSpell</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>F</td>
<td>11</td>
<td>Themba’s Journey</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
<td>M</td>
<td>8</td>
<td>What-What Mzansi</td>
</tr>
<tr>
<td>4</td>
<td>13</td>
<td>M</td>
<td>8</td>
<td>OpenSpell</td>
</tr>
<tr>
<td>5</td>
<td>13</td>
<td>M</td>
<td>8</td>
<td>(Free Exploration) KTuberling and Penguin games</td>
</tr>
<tr>
<td>6</td>
<td>15</td>
<td>F</td>
<td>10</td>
<td>(Free Exploration) Themba’s Journey</td>
</tr>
<tr>
<td>7</td>
<td>16</td>
<td>M</td>
<td>-</td>
<td>What-What Mzansi</td>
</tr>
<tr>
<td>8</td>
<td>14</td>
<td>M</td>
<td>-</td>
<td>Themba’s Journey</td>
</tr>
<tr>
<td>9</td>
<td>15</td>
<td>M</td>
<td>-</td>
<td>(Free Exploration) What-What Mzansi and Four-in-a-row game</td>
</tr>
</tbody>
</table>
3.3.2 Evaluation Process

In a conventional field study, participants are observed as they carry out normal or routine activities using the target system in the natural context of use either at home or the workplace. The natural context allows the observer to see the actual ways in which the system is being used; thus revealing some details that may be difficult to obtain if another evaluation method, such as the heuristic evaluation method, was used [Dumas, 2003].

In this study, the evaluation process was modified. Rather than merely observing participants while using the DD, pre-defined tasks were given to six of the nine participants while the other three were given the freedom to select any application they wished to interact with within an allocated time of 45 minutes. This enabled me to focus the evaluation on the specific interfaces and applications identified for the evaluation while at the same time allowing me to observe the type of applications the learners typically access.

To avoid disruptions to learning activities as much as possible, and minimize distractions from noise, evaluation sessions took place in the afternoons well after the official closing hour of the school.

Using the cooperative evaluation style, participants were encouraged to ask questions and assistance whenever they got stuck with any activity. For example, subtle hints and assistance were provided after allowing participants sufficient time to attempt to locate an interface element without success. This approach is justified since the DD is not a transaction processing system where the speed of task completion is a measure of usability. This approach actually enables participants to learn more about the functionalities of the DD and the specific application they used for the evaluation.

Nine evaluation sessions were conducted over a two-week period. Each session lasted between thirty and 45 minutes. The sessions were recorded on video cameras after assurance to participants of their anonymity. I also took notes of important events as they occurred.

After each session, footage of the evaluation was reviewed and compared with the facilitator note in order to check for any inconsistency between the two, before
preparing for the next day’s evaluation session. This was to ensure that data from the sessions were not mixed-up.

**3.4 User-based Evaluation with Questionnaires**

As an additional method of data triangulation, each participant was given a semi-structured questionnaire to evaluate the DD after the evaluation sessions. The questions in the questionnaires were based on the derived heuristic (Appendix A), although they were rephrased using simpler terminology to aid comprehension by novices. A sample questionnaire is included as Appendix E.

As stated in Section 3.3, evaluation sessions were conducted in the afternoons after the official school closing time to avoid disruptions to participants’ learning activities. The open area used for the evaluation meant that evaluation sessions were delayed for about thirty to 45 minutes after closing time to allow majority of the learners to have dispersed so that evaluation could be conducted with as little noise distractions as possible.

Because evaluation sessions were conducted in the afternoons, participants requested that they take the questionnaires home to complete and return the following day. This request was obliged because of the need to avoid as much inconvenience to the learners as possible. Moreover, participation in the study was voluntary. Of the nine participants, four returned the questionnaires the day after their evaluation sessions. One returned the questionnaire three days after the evaluation while another returned it several weeks after the evaluation. Three questionnaires were never returned.

**4 RESEARCH FINDINGS**

**4.1 Heuristic Evaluation Results**

Although Nielsen [1994] recommends calculating the severity of usability problems identified, severity ratings for identified problems could not be calculated following the heuristic evaluation due to the time lapses between evaluation sessions, since some evaluators would only get the combined problems months after their evaluation. Because evaluators could not easily access the DD again at their convenience, insisting on severity ratings could easily result in evaluator subjectivity as they could
not reasonably be expected to remember the nature of all the problems they had identified.

4.1.1 Total Problems Identified Per Interface/Application

A total of 71 problems (Table 4.1) were identified by the five expert evaluators. Eight (11.27%) problems were identified within the login screen, four (5.63%) are located in the new user account registration, thirteen (18.31%) problems were found within the main desktop, seventeen (23.94%) related to the quiz game What-What Mzansi, fourteen (19.72%) were located in OpenSpell and fifteen (21.12%) were in Themba’s Journey.

<table>
<thead>
<tr>
<th>Interface/Application evaluated</th>
<th>Number of Problems</th>
<th>Problem Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Login Screen</td>
<td>8</td>
<td>11.27%</td>
</tr>
<tr>
<td>New Account Registration Form</td>
<td>4</td>
<td>5.63%</td>
</tr>
<tr>
<td>Main Desktop</td>
<td>13</td>
<td>18.31%</td>
</tr>
<tr>
<td>What-What Mzansi</td>
<td>17</td>
<td>23.94%</td>
</tr>
<tr>
<td>OpenSpell</td>
<td>14</td>
<td>19.72%</td>
</tr>
<tr>
<td>Themba’s Journey</td>
<td>15</td>
<td>21.12%</td>
</tr>
<tr>
<td>Total Problems</td>
<td>71</td>
<td></td>
</tr>
</tbody>
</table>

The numbers in Table 4.1 showed that a combined total of 21 problems were found within the login screen and the main desktop. The combined number of problems within these two interfaces is more than that found in any other interface or application evaluated. These two interfaces constitute the first contacts that all users have with the DD, whether they are registered users or guests, the latter of which represents the majority of users. The problems related to these interfaces are therefore significant in that they could affect the majority of users. The spread of the problems identified per interface/application is graphically illustrated in Figure 4.1.
4.1.2 Descriptions of Identified Usability/Accessibility Problems

The expert evaluators identified a large number of usability and/or accessibility problems (71), many of which could impact on the success of user interaction with the DD, for example there were no feedback following incorrect username and/or password. In addition to identifying usability/accessibility problems, evaluators also provided suggestions for improvements or rectifications of the problems identified. A description of the combined usability and accessibility problems identified by the five evaluators, together with their recommendations for improvements is provided in Appendix F, a subset of the list (excluding recommendations) is given in Table 4.2.
<table>
<thead>
<tr>
<th>No</th>
<th>Heuristics violated</th>
<th>Problem description</th>
<th>Evaluator</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Login screen</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>16.1</td>
<td>The font sizes of the instructions on how to login/create user account in four other languages are small.</td>
<td>All</td>
</tr>
<tr>
<td>2</td>
<td>4.1</td>
<td>There is no feedback whatsoever when an incorrect username and/or password is provided.</td>
<td>1, 2, 3, 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>New account registration form</strong></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>13.2</td>
<td>There is no indication of which fields must be filled and which ones are optional.</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>19.1</td>
<td>User cannot use the &lt;Tab&gt; key on the keyboard to select female for the gender field.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Main desktop</strong></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2.2</td>
<td>One folder on the desktop has the caption ‘new_content’. This folder holds the educational games <em>What-What Mzansi</em>, <em>OpenSpell</em> and <em>Themba’s Journey</em>. This name is not descriptive of the contents.</td>
<td>All</td>
</tr>
<tr>
<td>6</td>
<td>2.2</td>
<td>The functionality of the right point button ⇒, used to exit the DD is not clear from its look. This button is also hidden from users’ view.</td>
<td>All</td>
</tr>
<tr>
<td>7</td>
<td>5.2</td>
<td>The locations of the following icons on the taskbar are too close to one another: the right point button ⇒ &lt;System&gt; &lt;Volume control&gt; and Volume control slider. Users can easily click on the ⇒ button while trying to use the volume control slider, thereby closing the system unintentionally.</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>What-What Mzansi</strong></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>3.2</td>
<td>At the start of the application, some of the control buttons and the character that reads out instructions and questions are hidden from user’s view. A full screen mode is activated by clicking on an icon that does not indicate this function.</td>
<td>All</td>
</tr>
<tr>
<td>9</td>
<td>2.4</td>
<td>The ‘&gt;’ icon in the &lt;About&gt; menu option is typically used for forward progression, however, clicking on it takes the user back to the main interface of the game.</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td>25.2</td>
<td>The volume control button is not visible when game is in full screen mode.</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>24.3</td>
<td>The performance feedback ‘don’t make me laugh’ after a poor performance is cheeky and not encouraging. Some users might find it offensive.</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>OpenSpell</strong></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>2.2</td>
<td>The use of the labels &lt;Say&gt;, &lt;Guess&gt;, and &lt;Spell&gt; are not descriptive of their functionalities.</td>
<td>All</td>
</tr>
<tr>
<td>13</td>
<td>16.4</td>
<td>The quality of the speech output is poor and not easily discernible even when the volume is at maximum level.</td>
<td>All</td>
</tr>
<tr>
<td>14</td>
<td>10.1, 10.2, 19.1, 22.3</td>
<td>When the &lt;Spell&gt; option is selected, the user cannot use the keyboard to provide input but must use the onscreen keyboard.</td>
<td>1, 2, 3, 4</td>
</tr>
<tr>
<td>15</td>
<td>2.2</td>
<td>The * symbols used to represent level of difficulty are not intuitive.</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Themba’s Journey</strong></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>1.1, 16.2, 22.1</td>
<td>To access an English version, the user must hover the pointer over the speech bubbles. This is problematic for users with limited use of their hands. The instruction provided under &lt;Help&gt; did not specify this. No user will know he/she must do this until told.</td>
<td>All</td>
</tr>
<tr>
<td>17</td>
<td>8.1</td>
<td>Themba’s journey provides an &lt;Exit&gt; button to close the application, while the same functionality is provided by the &lt;X&gt; button in <em>What-What Mzansi</em> and <em>OpenSpell</em>.</td>
<td>5</td>
</tr>
</tbody>
</table>
As shown in Table 4.2, some of the identified problems cut across the four heuristic categories. For example problem number fourteen “When the <Spell> option is selected, the user cannot use the keyboard to provide input but must use the onscreen keyboard” violates heuristics 10.1, 10.2, 19.1 and 22.3, which are general usability, direct accessibility and game heuristics.

### 4.1.3 Total Problems per Heuristic Category

An analysis of the total usability/accessibility problems identified was done according to which heuristic category was violated. Out of the 71 problems, 43 (60.56%) violated general usability heuristics. Only three (4.23%) problems violated the form-filling heuristics. Fifteen (21.12%) problems violated the direct accessibility heuristics, while 26 (36.62%) were related to game heuristics. Figure 4.2 graphically illustrates the total problems identified per heuristic category.

![Bar Chart](chart.png)

**Figure 4.2: Number of problems per heuristic category**

Of particular concern is the number of problems that violated general usability heuristics. Given that one of the aims of the DD project is the promotion computer literacy through unassisted learning [Cambridge, 2008], applications aimed at
promoting self-learning should support basic usability principles, such as simple and intuitive interfaces, adequate feedback and error prevention.

Figure 4.2 showed that only three of the identified problems violated form-filling heuristics. This was not surprising since the DD utilized a simple form to collect data about new user account. The number of direct accessibility problems identified were somewhat expected, because the DD was not designed with accessibility in mind. However, attention to direct accessibility guidelines can go a long way in improving usability for many users, even those without disability.

With regard to problems relating to game heuristics, many of these were also general usability problems. My belief is that addressing the usability problems will also address many of the game-related problems.

4.1.4 Variations in the Number of Problems Identified by Each Evaluator

Further analysis of total problems identified was based on the number of evaluators flagging each specific problem as such. Of the total 71 usability/accessibility problems identified, 35 were identified by single evaluators (not necessarily the same evaluator) and thirteen by all five. The remaining 23 problems were identified by multiple (two to four) evaluators. Figure 4.3 graphically illustrates the variations in the number of problems identified by single and multiple evaluators.

Figure 4.3: percentage of problems identified by single and multiple evaluators
Thirty-two of these problems were identified by evaluator 1 (45% of total problems), thirty-four by evaluator 2 (48%), thirty-three by evaluator 3 (46%), thirty-two by evaluator 4 (45%) and thirty-nine by evaluator five (55%). Figures 3.5 illustrates the total number of problems identified per evaluator while Figure 3.6 illustrates the problem percentage per evaluator relative to total identified problems.

Further analysis of problems identified by the expert evaluators was done according to heuristic category (Table 4.3).

1. **General usability heuristic category**: Evaluator 1 and 4 identified 22. Twenty-three problems were identified by Evaluator 2, while Evaluator 3 and 5 identified 21 problems respectively. The five evaluators identified a similar proportion of general usability problems, though not necessarily the same set of problems.

2. **Form usability heuristic category**: The least number of problems violated this heuristic category, with evaluators identifying between one and two problems.

3. **Direct accessibility heuristic category**: Problems relating to direct accessibility identified by the evaluators ranged from five to eight. Evaluator 1 and 4 identified five problems each while evaluator 2 identified seven. Eight problems were identified by evaluator 3 and 5.

   It was not surprising that evaluators 1 and 4 identified the lowest direct accessibility problems, since both mainly have experience in usability evaluation. Evaluators 3 and 5 have been involved in accessibility evaluations in the past, this account for the higher number of problems identified by these two. As for evaluator 3, a possible reason for the relatively higher number of identified problems when compared to evaluator 1 and 4 is that he manages a usability testing laboratory where participants can sometimes include those with disabilities. This may account for his awareness regarding accessibility issues.

4. **Game usability heuristic category**: Evaluator 1 identified nine problems; twelve were identified by Evaluator 2, eleven by Evaluator 3, fifteen by Evaluator 4 and eighteen by Evaluator 5. Evaluator 4 has been involved in various form of e-learning over an extended period of time, which might explain the significant number of game related problems identified, but no apparent reason could be given for the high number of game-related problems identified by Evaluator 5.
Table 4.3: Number of problems identified by evaluators per heuristic category

<table>
<thead>
<tr>
<th>Heuristic category</th>
<th>Evaluator 1</th>
<th>Evaluator 2</th>
<th>Evaluator 3</th>
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4.2 The Field Usability Evaluation Results

Various usability problems were encountered by participants and observed by the field evaluation facilitator. The total number of usability problems found during the field evaluation was 39. Thirty seven of these were software usability problems that affected task execution by participants while two were hardware related. Analysis of the specific interfaces and application in which the problems were located (Figure 4.4) showed that six problems occurred in the login screen, eight affected the new user account registration form, while six involved the main desktop. In the educational game applications, four problems related to the quiz game, What-What Mzansi, seven problems involved OpenSpell while six related to Themba’s Journey. The descriptions of the problems relating to specific interface and application are provided in sections 4.2.1 to 4.2.6.
Figure 4.4: Number of actual user problems per interface/application

4.2.1 Usability Problems Related to the Login Screen

The login screen is the first interface between the user and the DD. Users access content by logging in as a guest user, a registered user, or by creating a new user account and then logging in with the newly registered account. A guest user can simply access content of the Digital Doorway by typing ‘dd1’ in the username textbox. A new user account is created by typing ‘new’ in the username textbox; this will activate the registration form. The DD login screen is shown in Figure 4.5.
The six participants that were given predefined tasks created or attempted to new user accounts, two of the three participants that freely explored the DD also created new user accounts while the other participant accessed the system as a guest user.

Out of the eight participants who registered a new account, only two were able to log in with their username and password on first attempts while three participants successfully logged in following the second attempt. Three participants had to log in as guest users due to incorrect username and/or password provided by them. The usability problems related to the login screen were:

1. Following the submission of the registration form, participants were not sure how to proceed further. As shown in Figure 4.5, the login screen did not provide any information to users who have just registered or those with existing accounts. Some participants actually typed in ‘new’ or ‘dd1’ to login while others asked what should be done next before being told that the newly chosen username and password should be used to log in.

2. Participants sometimes confused the terms ‘surname’ and ‘username’. They typed their surname in the username field though this was not the chosen username.
3. Following incorrect username and/or password, the DD provided no feedback to participants. The same screen was returned again and again, with resultant visible confusion on participants’ faces.

4. A screen resolution dialog box appeared and disappeared after a few seconds with the message ‘For best picture quality change the resolution to 1024X. 1: Exit 2: Delete.’ This sometimes made participants to be frustrated as they did not know how to handle the information.

5. On two occasions, when participants were about to place the insertion point in the Username textbox, the following message appeared on a rollover ‘Answer questions here and press Enter when done. For a menu press F10’. While this message did not seem to bother the participants in this study, its relevance is questionable.

6. The DD login screen did not provide any prompt or hint for users to press the ‘Enter’ key or an onscreen <Enter> button next to the username and password field. Some participants did know what they should do after entering their usernames in the username text box. Two participants specifically asked me for help while I had to tell another what to do after spending some time unsure of the next required action, with visible confusion on his face.

7. Some participants confused the <Enter> key on the keyboard with the key designated for producing a ‘mouse click’ effect because the keys were not labelled. However, after pressing one without the desired effect they then pressed the other. This was one of the hardware-related problems.

The login screen-related usability problems experienced by participants in this study could have implications for the provision of Internet access through the General Packet Radio Service (GPRS) technology, which is currently being explored for the DD project. Using the technology, users are required to purchase and load the typical ‘pay as you go’ mobile phone recharge vouchers to get Internet access through the DD system. Any unutilized voucher balance can be used by the user at a later stage. Users of this service must log in to the DD as registered users in order for them to be able to use the credit balance in a voucher at a later stage. Use of the system as a guest (for example logging in with username ‘dd1’) means that any user who log in with the same username at a later stage can get Internet access using the credit balance in the
voucher loaded by a previous user who had loaded the voucher with the guest username ‘dd1’.

The success of provision of Internet access through the GPRS technology requires that users must be able to register an account and able to remember selected username and password. Currently, the DD does not support the retrieval of a forgotten username and/or password.

Without the provision of this functionality, there is high probability that users may not use the GPRS service since they must pay for this service and they are not assured of being able to utilize any unused credit balance at a later stage.

4.2.2 Usability Problems Related to the New Account Registration Form

Users who wish to create new accounts complete a simple electronic registration form, shown in Figure 4.6. Items on the form are organized into two main groups – ‘Personal Details’ and ‘User Details’. Within the personal detail group, user information such as name, age, and gender can be provided. User-selected username and password are chosen within the personal detail group. The form also provides users with hints on the type of data expected at certain fields, for example the password field. The form requires all data fields to be filled, although this is not explicitly specified in the form. After completing the form, the information provided is stored by clicking on the <Register user> button.
Figure 4.6: Digital Doorway user registration form

The usability problems relating to the registration form were:

1. The insertion point was not located within the first field at the start of the form. Some participants began typing their names only to realize later that the input was not being accepted and needed to place the insertion point within the first field before typing again.

2. None of the form fields is indicated as being mandatory or optional. Participants typically leave the home language, preferred language field unfilled only to have error messages urging them to fill the field.

3. Some participants chose passwords with the length less than six characters. This resulted in the following error message “Passwords must be between 6 and 14 characters”. This contradicted the hint provided next to the password field “6 to 10 characters”.

4. While setting the password, a user received the following error message “The password contains illegal characters”. This user could not comprehend the meaning of the error message. She had to ask the field observation facilitator for help.
5. The form did not facilitate the location of an error field. A user erased his input in the password field accidentally, while trying to correct the name field entry following an error message. The insertion point remained in the password field after clicking on the <Register user> button. Without the user realising this, he pressed the backspace button several times and erased the wrong field.

6. Two participants accidentally clicked on the <Cancel> button. This inadvertent user error resulted in the form being closed without any warning to the participant, thereby erasing all the data fields input thus far.

7. Some of the participants input their name and surname in the Name and Surname field without space in between them. This common error will then bring up the following error message “Your name seems to be incomplete”. Participants then spent some time trying to figure out what the problem is, sometimes without success until they were told what the problem is.

8. Three participants were unable to delete the wrong input in form fields until they were told how to. This task can only be accomplished by pressing a left pointing arrow key (←) on the keyboard, which then deletes the input one character at a time with each press of the key (This is a hardware (keyboard) usability problem).

The registration form enables DD developers to automatically gather demographic and application usage pattern data on the DD. This data, which is typically transferred to a central server on a daily basis [Gush et al., 2010], is only of value if accurate data can be collected. If users have difficulties in using the form, then there is little motivation to create own user accounts since content can easily be accessed through a guest log in.

Although the DD utilizes a simple form, with only two main groups of user data required, the nature of problems that participants encountered while filling the registration form affected the successful creation of user accounts. Error messages were provided in technical terms and they contradicted hints on the form. Users were not informed that all data fields are mandatory, participants who chose to leave some fields unfilled had to deal with error messages one after the other urging them to fill empty fields.

More crucially, the designers of the form did not anticipate or make provision for unintended user errors. As shown in Figure 4.6, the <Register User> and <Cancel>
buttons are located close to each other on the registration form. The proximity of these buttons could easily lead to any user (novice or experienced) inadvertently clicking on one, while the intention was to click on the other. An accidental click on the <Cancel> button by two participants in the study led to the closure of the registration form without any warning message and all the data entered by the participants were lost.

4.2.3 Usability Problems Related to the Main Desktop

Following a successful login, applications and content of the DD can be accessed by clicking on icons on the desktop or by selecting from the two menu options ‘Programs’ and ‘Resources’. The desktop, (Figure 4.7) also provides global volume control either by clicking on a ‘volume control’ icon or through a more advanced volume control window. Users can log out of the system by clicking on an ‘exit’ button (designated by a right pointing arrow ⇒) or from the ‘System’ menu. The usability problems associated with the main desktop are described below:

1. Out of the six participants that were given pre-defined tasks to complete using one of the applications, What-What Mzansi, OpenSpell or Themba’s Journey, only two were able to find the location of the applications on their own. Other participants searched for the applications within the <Game> submenu, which is located in the <Resource> menu unsuccessfully before they were told where to find them.

2. Only three of the six participants given pre-defined tasks were able to locate the volume control buttons on the desktop, the other three required assistance after several failed attempts.

3. After clicking on the required game application icon, the screen will flicker and return to DD home page. Participants needed to click the icon several times before the game application is opened. This was frustrating to the participants.

4. Four participants found the background colour to be too dark. On several occasions, they had to shield their faces and the screen with their hands while using the DD to overcome the extent of reflection of the sun on the dark background. The dark background was significantly worse than that experienced in the closed-up laboratory used by expert evaluators. The reflection worsened the contrast issue.
5. A participant accidentally clicked on the ⇒ button, used to exit the system, while trying to locate the volume control button and the system was shut down without any warning.

6. Only three of the six participants given pre-specified tasks were able to log out of the system on their own without requiring assistance. One participant discovered the ⇒ button accidentally following an attempt to increase the volume output. The other two participants specifically asked for help following failed efforts to exit the system on their own. Of the three participants that explored the system as they wished, two knew the location of the ⇒ button while the other participant asked for help after unsuccessful attempts to exit on her own.

![Digital Doorway desktop](image)

**Figure 4.7: Digital Doorway desktop**

The problems experienced by participants while attempting to access applications and use the resources provided on the main desktop again showed non-adherence to basic usability design principles. The educational game applications, What-What Mzansi,
OpenSpell and Themba’s Journey were hidden inside a folder with a name that did not convey the type of applications it contains. The icons used to access essential functions were not intuitive (for example, the ‘volume control’ and ‘exit’ icons).

One of the aims of the DD project is to promote computer literacy through unassisted learning [Gush et al., 2010]. This in essence means that the system should support exploration by users and have built-in mechanisms to guide against potentially ‘disastrous’ user actions. One of the participants in this study unintentionally clicked on ‘exit’ while searching for the volume control button. The system did not prompt the user to confirm that she indeed intends to log out of the system and shot down without any warning.

4.2.4 Usability Problems Related to What-What Mzansi

What-What Mzansi is an educational, general knowledge quiz game in the form of yes/no questions. Developed to provide content relevant to the South African environment, the program provides two levels of difficulty, <Easy> and <Advanced>. Context-specific instructions are provided when the user clicks on the <?> icon, located at the top right corner of the screen while the <X> icon closes the application. The interface (shown in Figure 4.8) provides three menu options. <About> menu presents the user with information on the Digital Doorway project and its achievements, together with details of the game developers. The questions are asked and answered when <play> is activated, while <hi-Scores> lists the scores of the top ten registered users. On the selection of a difficulty level, a local voice welcomes the player and reads out the questions which can be answered by clicking on <Yes> or <No>. Each session lasts 60 seconds. The score for each question can range from 2 to 10, depending on how fast the player answers it.
Two participants used What-What Mzansi, as part of pre-specified tasks while one of the free explorers chose to use the application. Problems experienced by the participants while using the application are the following:

1. The two participants given pre-defined tasks using this application could not find the game instructions as required in the specified task. Intuitively, the two participants clicked on <about> menu option to search for the game instructions without success. This is because this menu contains information on the application developers and Digital Doorway project history and achievements.

2. At the start of the application, some of the control buttons and the character that reads out instructions and questions are hidden from user’s view. A full screen mode is activated by clicking on an icon which does not indicate this function. None of the two participants who used this application knew how to get the full screen view of the game. One participant, who explored the Digital Doorway as wished, chose What-What Mzansi. This participant was able to change to a full screen view without requiring any help.

3. The context-specific instructions provided through the <?> icon was not utilized.
4. One of the terminals used for the evaluation sessions had unusually large icons. This resulted in non-visibility of a number of control buttons, in this instance a right pointing icon ‘>’ used for forward progression. This made it impossible for the participants to repeat the level which they had just completed as required following poor performance. Figure 4.9 shows a screenshot from this terminal.

![Figure 4.9: Screenshot from What-What Mzansi (with some icons and part of character hidden)](image)

The problems encountered by participants while using What-What Mzansi also affected the quality of interaction with the application. The choice of caption for the third menu option <about> was misleading. The participants expected to find the game instructions in this menu. In addition, the label did not follow industry standards and conventions. Typically, an <about> sub-menu is used within a <help> menu of applications to provide copyright and version information of a particular application.

The context-specific instructions provided through the <?> icon was not utilized the three participants. Question sessions begin immediately after the welcoming words by the program character without the user getting the opportunity to access the instructions.

Although context-specific instructions are available during question sessions, the participants did not access it. One reason could be that the main priority of the participants is to listen to and try to answer the questions as fast as possible since the
timer is running. Accessing the context-specific instructions will ‘eat away’ at the time available. Another possibility could be that the participants simply did not notice it.

One example of a necessary context-specific instruction is a description of the mechanisms for providing answers to questions. Although questions can be answered by pressing the left or right pointing arrow keys on the metal keyboard, none of the participants used this apparently more efficient method. Rather, the participants would use the touchpad to position the pointer over the correct ‘pot’ before pressing the ‘mouse click’ key above the metal touchpad.

4.2.5 Usability Problems Related to OpenSpell

OpenSpell is an educational spelling game that is available in all eleven South African official languages. It provides three levels of difficulty designated with *, **, ***. The interface, shown in Figure 4.10, includes an onscreen keyboard used for providing input in spelling exercises. The program provides three menu options. Clicking on <say> brings up a series of pictures of words to be spelt. For each word, a voice in the chosen language speaks out each letter as well as its pronunciation. <Guess> is based on the hangman word guessing game, while the <spell> option tests users’ spelling. Spelling exercises is done by clicking letters from onscreen keyboard. Users are given two opportunities to spell words, after which the correct answer is provided.

![Figure 4.10: OpenSpell interface (with the <say> menu active)](image)
Two participants were required to complete tasks involving the use of OpenSpell. Problems associated with the use of the application were:

1. In similar pattern to the participants who used What-What Mzansi, the two participants that were required to use this application could not find the game instructions. Both participants clicked on the <about> menu option to search for the game instructions, without success. This is because this menu contains information on the application developers and Digital Doorway project history and achievements.

2. The two participants who used this program selected the <spell> menu option when asked to learn the spelling of a few words. However, this functionality is provided within the <say> menu option.

3. Only one of the two participants was able to associate the * symbols with the level of difficulty. The other user did not know how to set the difficulty level.

4. The quality of the voice output was poor even when volume was at the highest. Participants frequently had to keep their ears close to the screen. Although quality speech output is a must have for users with hearing impairments, poor speech quality affected the usability of the OpenSpell application.

5. When asked to do some spelling exercises, both participants first attempted to use the keyboard to provide their input, only to realize later that they can only use the onscreen keyboard.

6. One of the terminals used for the evaluation sessions had unusually large icons. This resulted in the taskbar covering the control buttons <Repeat> <Erase> <Enter> almost completely. One participant who used this terminal had to ask what should be done to ‘enter’ her input for a spelling exercise. On two occasions, the participant needed to erase incorrect inputs but due to none visibility of these buttons, she clicked on the <Enter> button. This was taken by the system as an incorrect answer. She was then prompted to try one more time as the application interpreted this as an incorrect answer. Figure 4.11 shows a screenshot from this terminal.

7. The reflection from the sun affected the visibility of pictures displayed by the application due to the inadequate provision of shading from the sun. The reflection can be seen in Figure 4.11.
The developers of OpenSpell replicated non-adherence to industry standard and convention in the use of `<about>` menu. The fact that the participants who used OpenSpell also searched for the game instruction in `<about>` showed that this label can easily be interpreted as an application instruction, especially by users with limited computer literacy. Although What-What Mzansi provided the instructions for the game through the `<?>` icon, OpenSpell did not provide any form of instructions or help for users.

The labels and symbols were also unintuitive. The use of `<say>`, as the label for the functionality that provides the lessons to be learnt, is one example. As another example, stars (*) were used to represent the level of difficulty of the application. As discussed above, only one of the two participants who used the application was able to associate the stars with the difficulty level.

OpenSpell required users to click on the onscreen keys on the application interface to provide input during spelling exercises. The keyboard cannot be used as input device, this is an unnecessary restriction. Moreover, the first intuition of the participants who used the application was to press the keys on the keyboard.

The DD at this particular school was installed in an open area along one of the school’s corridor. While I commend the desire of the DD team to install the system at
publicly accessible locations, little consideration was given to the extent of usability problems that could arise from the reflection of the sun on the system. The tarpaulin that hung from a wall (to counter the reflection from the sun) was only provided after my first visit to the school in the company of members of the DD team, when I noticed the problem. The field evaluation has shown that the tarpaulin did not provide sufficient shading from the sun’s glare.

4.2.6 Problems Associated with Themba’s Journey

Themba’s Journey is a life skills program in the form of a narrative. Themba is a young man who makes a journey from his village to the city of Johannesburg in search of a job. Throughout the narration, Themba is faced with potential life-changing situations that require him to make choices. The user, who assumes the role of Themba, must make these choices for him, for example, whether or not to take drugs. Each decision can result in positive or negative consequences. The interface (Figure 4.12) provides three menu items. The <Help> menu contains the navigation and game instructions. The main story is narrated within the <Play> environment. Clicking on <Exit> closes the program.

The game is available in both Xhosa and English languages. The default language is Xhosa, available in text and spoken words. The English version is only available in text and can be accessed when the user hovers the pointer over the speech bubbles.

Two participants completed tasks related to the use of Themba’s Journey while one of the free explorers chose to use the application. The usability problems associated with Themba’s Journey were:
1. The default language for this application is Xhosa. To access an English version, the user must hover the mouse on speech bubbles. The three participants who used the application (two with pre-defined tasks and one as a free system explorer) did not know how to get the English version until I told them what to do.

2. Too much physical effort was required by participants to move the pointer around the speech bubbles to read English versions. Their fingers became damp on several occasions due to constant movement over the touchpad to position the pointer.

3. Application background was very dark. Participants had to shield their faces and screen with hands. The dark background is made worse because the DD is located in an open space with excessive natural lighting and glaring of the sun.

4. Navigation instructions were provided in the <Help> menu. Although the participants read the instructions at the start of the session, they had forgotten about the functionality of some of these buttons, in this instance the <Skip> button by the time they were actually needed.

5. At the second crossroad, which was having the options ‘Walk’ and ‘Take taxi’, the ‘Walk’ option could not be executed. A participant had to select the ‘Take taxi’ option against her wish.
6. The main exit button was non-functional. Participants had to close the application with the browser exit button i.e. the <X> button.

Themba’s Journey represents one of the poor design decisions made by DD application developers. Although the application is embedded in scenarios that many young South Africans can relate to, such design decisions can limit the number of young people who can potentially benefit from the useful information contained in the application.

The application is available in both the IsiXhosa and English languages, but the three participants were unable to access the English equivalent without assistance from the evaluation facilitator. Also, frequent finger movements over the touch pad resulted in dampness, which the participants needed to dry on several occasions.

As discussed above, the lack of adequate shading meant that there was a constant glare of the sun over the DD screen. The dark background of Themba’s Journey was aggravated by the reflection of the sun when using the application at the school.

Inadequate testing before the deployment of the application was also revealed by the inability of a participant to execute the “Walk” option at one of the application’s crossroads. In addition participants could not close the application using either the <Exit> button provided on each screen of the application, or from the main interface <Exit> button.

### 4.2.7 Hardware Problem

The primary purpose of the study was to evaluate a selection of interfaces and applications, however, the evaluation revealed a number of keyboard keys that were not functioning. These are: letters ‘K’, ‘L’, ‘O’, and ‘P’. This affected the choice of passwords selected by some participants.

#### 4.2.7.1 Other Applications Used by the Free Exploration Participants

As stated in Section 3.2.1, three participants were allowed to freely explore the DD as they wished. This subsection discusses the types of applications used by these participants.
One of the free exploration participants elected to use Themba’s Journey, while another chose What-What Mzansi and the logic game four-in-a-row. The third participant used the KTuberling and Penguin games.

- **Four-in-a-row game:** Four-in-a-row is a multi-player logic game involving the computer and a human player. The main objective is to get four balls or dicks along a straight line vertically, diagonally or horizontally before the opponent.

- **KTuberling game:** KTuberling, otherwise known as the potato guy, is a construction game where the player ‘dresses up’ a potato character by attaching body parts and clothing accessories such as eyebrows, nose, or a hat to the character. The player is presented with a potato structure together with an object area from where different objects can be dragged and dropped on the potato guy. The game neither has a winner nor a looser, with the main goal being to construct a character the player wishes. The process of constructing the character improves the drag and drop skills of the players. The game can also be used to learn parts of the body as the name of the selected part are spoken out.

- **Penguin game:** This is a racing game where a penguin paddles along a snow-covered mountainous terrain. It collects herrings while paddling towards the finish line. The player controls the racing penguin using the arrow keys on the keyboard. At the end of the game, the number of herrings collected is displayed on the screen. The penguin game is one of the favourite games at this centre as learners have been observed on several occasions playing the game.

During the two-week period of conducting the field studies, children were observed informally as they gather around the DD to access programs and resources available in the system.

The DD is installed on one of the school’s corridor. This open area makes the system accessible even to children from around the school’s neighbourhood. Children from the neighbourhood can freely use the computer after school hours until 18:00 in the evening.

Although many children were unaware of the three educational games evaluated during this study at the start of the evaluation, by the end of first week, many have come to enjoy the quiz game What-What Mzansi.
The availability of the DD has certainly resulted in the acquisition of basic computer skills among the children. However, attention to usability principles will go a long way in ensuring the success of the project.

4.3 Analysis of Questionnaire Responses

As a user-based evaluation method, a selection of the heuristics used by expert evaluators were converted to questionnaires (in the form of positive statements) using simple terms that can be understood by novices. Participants provided ratings of their agreement or disagreement to these statements using a five point Likert scale, namely, *Strongly agree, Agree, Neither agree nor disagree, Disagree, and Strongly disagree.*

Qualitative analysis of the questionnaires showed discrepancies between participants’ only six of the nine participants returned their questionnaires. Of the six participants, three participants did not provide a rating to several of the statements, and when they did provide a rating, the answer always varied between *strongly agree, agree, or neither agree nor disagree.* These positive responses were contradictory to what was observed during observations. For example, to the statement, “I am able to determine the meaning and purpose of signs and symbols used in the Digital Doorway”, two of these three participants ticked *Agree.* However, one of them was unable to locate the volume control and exit buttons on the desktop without assistance while the other could not set the level of difficulty in OpenSpell.

The remaining three participants selected a rating to all the statements and provided additional feedback to some statements.

The following list reproduces verbatim the comments by the remaining three participants:

- “The projection of the voice is very low even though you up the volume it is still the same”.
- “The screen is very dark for you to see the Themba game”.
- “It is not easy for me to shut down the Digital Doorway”.
- “At some times the instructions are not clear, especially if you are a new user and the words that are used don’t explain everything clearly”.
• “I can’t change the volume because it is not written where is the volume you just have to find it yourself which is not good”.

• To the statement “The Digital Doorway gives response within a short time” two participants provided the following comments:
  o “Sometimes the system is very slow and we go away”.
  o “It takes time which we do not have. Something must be done”.

• To the statement “I am able to determine the meaning and purpose of signs and symbols used in the Digital Doorway” the following comment was provided by a participant:
  o “No, they have to be written, not putting symbols and expect us to find where is what. I mean that’s not good”.

• To the statement “It is easy for me to choose in which language I want to play a game” the following comment was provided by a participant who used the application Thembà’s Journey:
  o “It is hard for you to choose the language because you won’t see where you should choose the language”.

• To the statement “The Digital Doorway shows me how to correct my mistake” two participants commented:
  o “Not at all times, sometimes you don’t even know you’ve made a mistake”.
  o “Not all the times I sometimes have to get my teacher to help me”.

Although the questionnaire method was used as a data triangulation method in the study, the responses from participants highlighted some of the problems associated with the use of questionnaires as mentioned in Table 2.1. This is why multiple evaluation methods are typically used in practise.

4.4 Comparison of the Three Evaluation Methods

As discussed in section 2.1, each evaluation method has benefits and limitations. Combining an expert evaluation method like heuristic evaluation with one that involves user participation, especially in a natural environment of use, allows one method to offset the shortcomings in the other, for example by revealing problems that were not picked up while using the other method.
The results obtained in this study, using heuristic evaluation method, field usability study, and questionnaires, illustrate the value of using a combination of usability evaluation methods. The heuristic evaluation method highlights what experts believe could constitute potential problems for users while the field evaluation revealed actual problems that impacted on users’ tasks. In general, the heuristic evaluation method yielded the kind of usability errors that can be seen as predictable while the field usability evaluation produced additional errors that are generally unpredictable. An example of this occurred in the use of the terms ‘username’ and ‘surname’, where the experts could distinguish between the two, whilst some users confused the two.

The heuristic evaluation method identified a large number of usability and/or accessibility problems, many of which affect successful interaction with the DD, for example absence of feedback. Some of the problems could be classified as low-severity problems that may not necessarily affect users’ tasks. Examples of these includes the lack of consistency in the use of upper and lower case letters for interface elements captions and the layout of log-in instructions.

Additional problems that surfaced in the field study were not recognized by expert evaluators. This includes the DD’s lack of error tolerance. For example, none of the expert evaluators recognized the close positioning of the two buttons <Register User> and <Cancel> in the new user account registration form as problematic, but two participants clicked on the <Cancel> button accidentally and the form was closed without any warning.

Furthermore, some of the concerns raised by expert evaluators were inconsequential for the participants in this study (for example, the small instruction font size and the sarcastic performance feedback); however, they could easily constitute problems for other users. Attention to as many of the potential problems as possible will improve general usability for a wider spectrum of users.

Comparison between the data obtained from the field usability study and questionnaires showed the kind of inconsistencies that may arise between what users say and what they actually do. For example, responding that they understood the meaning of symbols and icons when in reality they were unable to determine their purpose.
Results from the three evaluation methods have shown their complementary roles. However, of the three methods, evaluation by questionnaire was the least effective. With the questionnaire method, one is absolutely reliant on the willingness of the participants to complete the questionnaires with total honesty. As stated in Section 4.3, the responses provided by three participants were in contradiction to their behaviour during their evaluation sessions.

In the same vein, certain issues that were not picked up as problems showed up as real problems where users are concerned. For example, none of the expert evaluators see the close positioning of the two buttons <Register User> and <Cancel> in the new user account registration form as problematic. Using the heuristic evaluation method, more accessibility and game-related problems were identified than in the field study. The reason for this could be because none of the participants in the field study had any apparent disability.

5 Conclusion

This technical report provides the findings from the usability and accessibility study conducted on the DD. Evaluation was done using the heuristic evaluation method, field usability study and questionnaires. Result from the evaluation revealed non-compliance with basic usability and direct accessibility principles by developers of DD applications.

In addition to identifying usability/accessibility problems, expert evaluators also provided their recommendations for improving/correcting the problems.

Evaluation heuristics used in this study can also be used as guidelines by DD application developers.

6 References


## Appendix A: Heuristic evaluation criteria

<table>
<thead>
<tr>
<th>H_No</th>
<th>Heuristics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Category 1: General Usability Heuristics</strong></td>
</tr>
<tr>
<td>1</td>
<td><strong>Support user efforts to learn and use the Digital Doorway.</strong></td>
</tr>
<tr>
<td>1.1</td>
<td>Provide information that will enable users understand how to interact with the Digital Doorway using clear and simple terminologies.</td>
</tr>
<tr>
<td>1.2</td>
<td>Provide clear indication of what the next required action is.</td>
</tr>
<tr>
<td>1.3</td>
<td>Make system behaviour predictable by enabling users to determine the effect of future action based on their past interaction history.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Support users in the application of other computer or real world experiences while interacting with the Digital Doorway.</strong></td>
</tr>
<tr>
<td>2.1</td>
<td>Avoid the use of technical terms</td>
</tr>
<tr>
<td>2.2</td>
<td>Icons, labels and symbols should be intuitive and meaningful to users, taking into account user context and experience.</td>
</tr>
<tr>
<td>2.3</td>
<td>Ensure that information sequence and layout appear in natural and logical order.</td>
</tr>
<tr>
<td>2.4</td>
<td>Follow and adhere to platform and industry standards and conventions.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Ensure that user’s short-term memory is not overloaded.</strong></td>
</tr>
<tr>
<td>3.1</td>
<td>Users should not use considerable cognitive resources trying to interpret the meaning of icons and symbols and to navigate the interface.</td>
</tr>
<tr>
<td>3.2</td>
<td>Objects, options, and permissible actions should be visible so that users do not have to remember instructions.</td>
</tr>
<tr>
<td>3.3</td>
<td>Audio instructions should be given close to when the user is expected to act on them.</td>
</tr>
<tr>
<td>3.4</td>
<td>Users should not be required to remember information from one screen to another.</td>
</tr>
<tr>
<td>4</td>
<td><strong>Provide observable and informative feedback regarding change in system state.</strong></td>
</tr>
<tr>
<td>4.1</td>
<td>Feedback should be provided in clear and unambiguous terms.</td>
</tr>
<tr>
<td>4.2</td>
<td>Any change in the state of the system following user action should be perceivable to enable the user associate the change to the action that caused it.</td>
</tr>
<tr>
<td>4.3</td>
<td>Response to user action by the system should be instantaneous. Where this is not possible, the system should indicate that the task is in progress to avoid repeated clicking by user.</td>
</tr>
<tr>
<td>5</td>
<td><strong>The application should be tolerant of user’s mistakes.</strong></td>
</tr>
<tr>
<td>5.1</td>
<td>Provide support for system exploration by the user by allowing easy reversal of actions.</td>
</tr>
<tr>
<td>5.2</td>
<td>Prevent user error by using appropriate constraints at strategic points.</td>
</tr>
<tr>
<td>6</td>
<td><strong>Help users recognize, diagnose and recover from errors.</strong></td>
</tr>
<tr>
<td>6.1</td>
<td>Error messages should be context-specific in relation to the action performed.</td>
</tr>
<tr>
<td>6.2</td>
<td>Error messages should be given in language comprehensible to users, not technical terms.</td>
</tr>
<tr>
<td>6.3</td>
<td>Error messages should precisely describe what the problem is and offer ways of solving them.</td>
</tr>
<tr>
<td>7</td>
<td><strong>Keep interface elements simple through minimalist design.</strong></td>
</tr>
<tr>
<td>7.1</td>
<td>Ensure that the interface is not cluttered with irrelevant information, control buttons and icons.</td>
</tr>
<tr>
<td>7.2</td>
<td>Provide information and control options close to when the user is required to make use of them.</td>
</tr>
<tr>
<td>8</td>
<td><strong>Ensure internal consistency within and across Digital Doorway applications.</strong></td>
</tr>
<tr>
<td>8.1</td>
<td>Be consistent in the naming conventions used for icons, symbols, and objects.</td>
</tr>
<tr>
<td>8.2</td>
<td>Make sure that the same terms, actions, or symbols mean the same thing across applications.</td>
</tr>
<tr>
<td>8.3</td>
<td>Similar user actions should result in similar effects/system response across applications.</td>
</tr>
<tr>
<td>8.4</td>
<td>Create the same ‘look and feel’ effect across applications so users can extend knowledge to similar situations.</td>
</tr>
</tbody>
</table>

| 9 | **Match between component labels and their contents.** |
| 9.1 | Ensure that labels/titles for icons, menus and symbols accurately describe their content. |
| 9.2 | Component labels/titles should not mislead users into accessing content they would otherwise not be interested in. |

| 10 | **The Digital Doorway should support multiple ways of interaction between it and the user.** |
| 10.1 | The Digital Doorway should not impose unnecessary constraints on user input method. |
| 10.2 | Where user input can be provided via the keyboard and onscreen keys, the user should be free to provide input through either method. |
| 10.3 | The Digital Doorway should support multiple output methods. |

**Category 2: Form-Filling Heuristics**

| 11 | **Provide support for easy navigation around form elements.** |
| 11.1 | Provide visible cue by positioning the cursor in the first field at start of the form-filling dialogue. |
| 11.2 | Cursor movement should follow the order in which form elements are organized. |
| 11.3 | Users should be able to edit data fields by moving the cursor backward and forward, rather than having to retype the whole field. |

| 12 | **Organize form elements in a logical way.** |
| 12.1 | Ensure that related items are grouped together to aid readability. |
| 12.2 | Provide visual reinforcement for element groups through efficient use of white spaces and borders. |

| 13 | **Provide adequate information to enable successful completion of form.** |
| 13.1 | Ensure that required information is clearly specified. |
| 13.2 | Designate required fields in standard and consistent ways. |
| 13.3 | Give feedback for missing data fields in clear and unambiguous terms, taking into account user’s age and knowledge. |
| 13.4 | Avoid requesting for irrelevant information. |

| 14 | **Ensure that data entry fields are associated with appropriate captions/labels.** |
| 14.1 | Give meaningful names to field captions/labels, taking into account user’s age and experience. |
| 14.2 | Ensure that captions/labels are distinct from data entry fields. |
| 14.3 | Be consistent in the alignment of captions/labels. |

| 15 | **Ensure that data entry field length is sufficient for the size of required data.** |
| 15.1 | Clearly specify the limit for data having minimum or maximum allowable length. |

**Category 3: Heuristics to support direct accessibility**

| 16 | **Provide information that is perceptible to users with varying ability.** |
| 16.1 | Font size of instructions should be large enough to enable easy perception by users with low vision. |
| 16.2 | Information should be accessible without undue physical efforts. |
| 16.3 | Important information should be clearly distinguishable from other peripheral contents. |
| 16.4 | Provide audio equivalent of instructions and information to afford access by users who cannot read. |
16.5 Provide quality speech output that enable users hear and comprehend their meanings.

17 **Ensure that feedback is accessible to users regardless of their ability.**

17.1 Provide feedback using multiple modes to facilitate access and comprehension.

17.2 Text equivalent of graphic or audio information should convey the same message.

18 **Do not rely on colour alone to code and distinguish.**

18.1 Ensure that colour alone is not used to represent important information.

18.2 Ensure that background and text colours contrast well with each other.

19 **Allow complete and efficient usage of the keyboard.**

19.1 Allow keyboard navigation for operations/tasks that do not essentially require use of the mouse.

19.2 Ensure that all links, menus and buttons are accessible using the keyboard.

20 **Allow user control of audio-visual information.**

20.1 Avoid automatic progression from one screen to the next for audio-visual information; users should explicitly select forward/backward progression.

20.2 Provide controls that enable users to pause, continue, or repeat audio-visual information.

20.3 Users should be able to adjust the volume of audio information.

20.4 Equivalent alternatives for audio-text information should be synchronized.

### Category 4: Game-specific Heuristics

21 **Ensure that the goals, aims and objectives of the game are explicitly specified.**

21.1 Games should have clear goals and objectives.

21.2 Make it easy for the user to infer the goals and objectives whenever these are not clearly specified.

21.3 Ensure that users can easily determine whether they are getting closer to the goal.

22 **Make users aware of the rules of the game.**

22.1 Provide an easily accessible instruction on how to play the game.

22.2 Permissible actions should be clearly specified.

22.3 Clearly specify constraints and restrictions governing the game.

23 **Provide appropriate level of user control.**

23.1 Users should be able to adjust the game’s level of difficulty.

23.2 The application should be able to adjust the level of difficulty based on user performance.

23.3 Whenever appropriate, give learners the option of returning to where they left off when the program is temporarily exited.

24 **Provide appropriate level of challenge, learner motivation and self-esteem.**

24.1 Ensure constant challenge through adjustable difficulty level.

24.2 Whenever appropriate, provide challenge in the form of hidden information.

24.3 Performance feedback should not be given using negative or sarcastic statements.

24.4 Provide constructive and corrective feedback that will enable player learn from mistakes and improve future performance.

25 **Provide adequate control mechanisms to support easy navigation.**

25.1 Provide user control options for forward progression to facilitate skipping a section and backward progression, which enables the review of a previous section.

25.2 All control mechanisms should be visible and easily accessible.
| 25.3 | All control mechanisms should be easy to use without requiring undue physical efforts. |
| 25.4 | Provide clear exit route to enable users leave the game at any stage. |
| **26** | **Recognize and respect user’s socio-cultural and language diversity.** |
| 26.1 | Game should be accessible in different languages. |
| 26.2 | Game content should not be biased against specific cultural or gender groups. |
| 26.3 | Game activities should be embedded in scenarios that users can relate to. |
Appendix B: Information document for expert evaluators

Researcher: Funmi Adebesin fadebesin@csir.co.za

Dear evaluator,

Thank you for taking part as an expert evaluator for the Digital Doorway.

- Please take time to familiarize yourself with the following documents to be used in the evaluation process. The documents are:
  1. *DD_HE_Information*, Page 1 of this document,
  2. *DD_HE_System-Overview*, Page 2 – 4 of this document,
  3. *DD_HE_User-Profile*, Page 5 of this document,
  4. *DD_HE_Eval-Proc*, Page 6 of this document,
  5. *DD_HE_Expert-Profile*, a separate document,
  6. *DD_HE_Eval-Criteria*, a separate document and

- Please provide the information required in the document, *DD_HE_Expert-Profile*, and e-mail it to me at: fadebesin@csir.co.za.

- Please let me know when you will be available to perform the evaluation on the Digital Doorway at the Meraka Institute of the CSIR between 15 September 2009 and 30 November 2009; the evaluation should take about two hours.

- The evaluation session should last approximately 2 hours. I will facilitate the session by acting as the scribe. This will allow you to concentrate on the most important thing – identifying usability/accessibility problems in the Digital Doorway. After the evaluation, I will compile a report of usability/accessibility problems identified which will be sent to you within two days. Please verify this report to ensure that it is a true reflection of the evaluation session.

- Please e-mail the verified report together with any comment to me at: fadebesin@csir.co.za.

Should you require further information regarding the evaluation, please contact me at the above e-mail address or call 012-841-3373. Once again, thank you for evaluating the Digital Doorway.
Application to be evaluated: The Digital Doorway

The Digital Doorway is a non-standard, non-web based computer system developed as a joint initiative between the South African Government’s Department of Science and Technology (DST) and Meraka Institute of the Council for Scientific and Industrial Research (CSIR). The computer is housed in a rugged, custom-designed kiosk with three terminals to curtail vandalism. It has metal keyboards with metal trackballs that enable simultaneous access by three users. One of the terminals acts as a server, which runs on the Ubuntu Linux operating system. The other two terminals are diskless clients and access files from the file server. Some of the programs and applications in the Digital Doorway were developed in-house while a large number of them are third-party resources and programs.

It is based on the ‘Hole in the Wall’ concept from India, where Mitra and Rana (2001) demonstrated people’s innate ability to acquire basic computing skills through experimentation and self-discovery provided that the technology is made available in an environment conducive to experimentation.

This evaluation will be limited to those applications developed in-house by the Digital Doorway team; in particular, the evaluation will be restricted to the Digital Doorway interface, the form-fill dialogue for creating a user account, the educational quiz game, What-What Mzansi, the life-skills teaching game, Themba’s journey, and spelling teaching program, OpenSpell. Accessibility evaluation will be restricted to the direct accessibility features built into the Digital Doorway.

Educational games to be evaluated

What-What Mzansi

*What-What Mzansi* is quiz game in the form of yes/no questions. The interface includes three menu items: <Play>, <Hi-Scores>, and <About> *What-What Mzansi* is only available in English.

**About:** This menu option mainly contains information on the Digital Doorway project and its achievements.

**Play:** As the name suggests, this is where the questions are asked and answered. There are two levels of difficulty from which a player can select: ‘Easy’ and ‘Advanced’. On the selection of a level, a local voice welcomes the player and reads
out the question which can be answered by clicking on ‘Yes’ or ‘No’. Each question lasts 60 seconds; the score for each question can ranges from 2 to 10, depending on how fast the player is able to answer it; for instance, if the player clicked on yes when the score mark is on 6, then his/her score will be 6 if the answer is correct. However, if the answer is wrong, the score value will be deducted from the current total score. At the end of the session, all the questions are presented again with the correct answers. If the player has performed well, he is informed of his readiness to move to the next level; otherwise he can repeat the session.

**Hi-Scores:** This submenu lists all the high scores registered for a number of users so far for the game.

**Thembà’s Journey**

This is a life skills game that tells the story of Themba, who makes a journey from his village to the city. The main interface includes three menu items, <Help>, <Play>, and <Exit>.

The Help> menu contains navigation instructions and instructions on how to play the game. The <Play> menu is where the main story is narrated, while the <Exit> menu enables users to close the program.

At strategic places, Themba reaches crossroads where the user has to make decisions on his behalf on a course of action, with each action having a positive or negative consequence. The game is available in both Xhosa and English languages.

**Open Spell**

*Open spell* is an educational spelling game. It is available in all the eleven South African official languages from which the user can select. There are three difficulty levels to choose from.

The interface presents three menu options <Say>, <Guess> and <Spell>. It also includes letters of the alphabet, similar to a keyboard and three buttons <Repeat>, <Erase>, and <Enter>.

**Say:** Selecting this menu option brings up a picture of the term to be spelt one after the other. A voice in the selected language speaks out each letter of the term as well as the pronunciation of that term.
**Guess:** This functionality is based on the hangman word guessing game. The specific word to be guessed is presented as dashes which represent the number of alphabets in the word. The player selects a letter of the alphabet from the screen by clicking on it. If the chosen letter appears in the word it is slotted in the appropriate dashed space(s). With each incorrect guess, a bird is perched on a tree branch accompanied by an audio effect of the branch breaking-off the tree. This process is continued until the player guesses the correct word or the tree branch breaks off and the birds fall down.

**Spell:** When this option is selected, a picture is presented and the name/meaning of that picture is read out. The player is then prompted to spell the word. Spelling is done by clicking the letters on the screen, when the player completes the exercise he/she clicks on the <Enter> button. If the first attempt is wrong, a second attempt is allowed after which the correct answer is provided. The <Erase> button can be used to delete previous letters during the spelling exercise.

**Profile of Digital Doorway Users**

The age of Digital Doorway users vary from primary school children to older adults, depending of where it is installed. Typically, a number of users converge around a single terminal to work as a group, showing one another how to operate the system. The group size varies from four to twelve. Digital Doorways are designed to support self-learning through experimentation; this means that users may not even have seen a computer before.

For this study, user observation will be conducted at a local high school with a Digital Doorway installed. It can thus be assumed that users’ age will vary from thirteen to seventeen, with users having no prior computer literacy.
Heuristic evaluation procedure for the Digital Doorway

1. Log-in as a guest user by following the instruction on the screen.

2. Open the new_content folder to access the educational games, *What-What Mzansi, Themba's Journey*, and *Open Spell* in whatever order you wish and familiarize yourself with the games.

3. Thereafter, log out.

4. Examine the log-in interface, relating all associated usability/accessibility problems and the heuristics violated to the scribe who will make notes. Please be specific when describing problems and their locations.

5. Now, create a new user account by completing the user registration form.

6. This form is one of the interfaces being evaluated; using the set of heuristics provided, relate all the associated usability/accessibility problems and the heuristics that were violated in this form-filling dialogue.

7. Log-in using the user-name and password you have chosen.

8. Now re-access *What-What Mzansi, Themba's Journey*, and *Open Spell* one after the other in whatever order you wish and evaluate each game using the set of heuristics provided.

9. While evaluating each game in turn, relate all usability/accessibility problems in each game as well as the heuristics that has been violated to the scribe.

10. For each problem identified, please provide recommendation(s)/solution(s) to the problem, if you can.

11. After completing the evaluation, the scribe will compile a report of all usability/accessibility problems identified. The evaluation report will then be mailed to you within two days of the evaluation at the latest. Please review the report to ascertain that it reflects the evaluation process, adding comments as required. The reviewed report should then be mailed to: fadebesin@csir.co.za.

Please accept my sincere appreciation for taking part in evaluation the Digital Doorway.
USABILITY EVALUATION OF THE DIGITAL DOORWAY

Contact: Funmi Adebesin at fadebesin@csir.co.za or 012 841 3373

PERMISSION TO CONDUCT RESEARCH AT GATANG SECONDARY SCHOOL

Dear Sir/Madam

My name is Funmi Adebesin. I am a Masters Studentship holder from the Meraka Institute of the CSIR and studying at University of South Africa (UNISA). My research involves evaluating the usability of the Digital Doorway, i.e. how easy the computer is to use. As part of my research, I wish to conduct field observations at your school where I will observe learners using the Digital Doorway. After using the Digital Doorway, learners will also complete a questionnaire where they will assess the Digital Doorway.

The purpose of the study is to evaluate the Digital Doorway and not the ability of the learners. Information collected from learners will assist in improving future versions of the Digital Doorway.

Permission for learners to participate will also be obtained from their parents/guardians. All information collected will be treated as private and confidential and the identity of the learners will not be revealed. Participation of learners in this study is absolutely voluntary and they are free to withdraw their participation even after their parents have signed the consent form.

Should you wish to obtain further information regarding the evaluation please do not hesitate to contact me at the above address.

I will be grateful if you would give me your permission to conduct the study at your school.
Yours sincerely

Funmi Adebesin

I, _________________________________ the principal of, ________________________________ hereby consent to your performing your research at my school.

Signature: __________________________ Date: ________________________
Appendix D: Consent form for participants' parents/guardians

USABILITY EVALUATION OF THE DIGITAL DOORWAY

Contact: Funmi Adebesin at fadebesin@csir.co.za or 012 841 3373

PERMISSION FOR LEARNER TO PARTICIPATE IN RESEARCH

Dear Sir/Madam

My name is Funmi Adebesin. I am a Masters Studentship holder from the Meraka Institute of the CSIR and studying at University of South Africa (UNISA). My research involves evaluating the usability of the Digital Doorway, i.e. how easy the computer is to use. As part of my research, I wish to conduct field observations at Gatang secondary school where I will observe learners using the Digital Doorway. After using the Digital Doorway, learners will also complete a questionnaire where they will assess the Digital Doorway.

The purpose of the study is to evaluate the Digital Doorway and not the ability of the learners. Information collected from learners will assist in improving future versions of the Digital Doorway.

Permission to conduct the research at Gatang has also been obtained from the principal. All information collected will be treated as private and confidential and the identity of the learners will not be revealed. Participation of learners in this study is absolutely voluntary and they are free to withdraw their participation even after you have signed this consent form.

Should you wish to obtain further information regarding your child’s participation in the evaluation please do not hesitate to contact me at the above address.

I will be grateful if you would give permission for your child to take part in the study.
Yours sincerely

Funmi Adebens

I, ________________________________________________________________

Parent/guardian of ____________________________________________ hereby permit

him/her to participate in your research.

Signature: __________________________________ Date: ______________
Appendix E: Questionnaire for user evaluation

Questionnaire for evaluating the Digital Doorway

Information to participants

Purpose of the questionnaire: The main purpose of this questionnaire is to evaluate the usability (i.e. the ease of use) of the Digital Doorway. It is not an assessment of the ability of you as a participant. Your honest comments based on your personal experience with the Digital Doorway will assist improving future versions of the Digital Doorway.

Use of data: Information collected through this questionnaire will be used for research purposes only.

Anonymity of participants: All the information that you provide will be treated as private and confidential and your identity will not be revealed.

Voluntary participation: Your participation in this study is absolutely voluntary. You have the right to withdraw from the study at any time.

How to complete the questionnaire

You need to have used the Digital Doorway before completing this questionnaire. The purpose of the first part of the questionnaire is to get to know you a little bit better.

For the evaluation statements, please tick the box that best fit your agreement with each statement. Thereafter, you are requested to write specific problems you have encountered that relate the statement in the space provided. If the space provided is not sufficient, you may use more paper to write you comment.
**Background information**

Name: ____________________________________________

Age: ___________

Gender:  Male  Female  

What grade are you? ___________

Have you used a computer before? Yes  No  

If yes, when was the last time you used a computer? ___________

Have you used the Digital Doorway before? Yes  No  

If yes, how many times do you use the Digital Doorway in a week? ___________

Which program(s) have you used previously in the Digital Doorway?

___________________________________________________________________

___________________________________________________________________

Which program(s) in the Digital Doorway do you use on a regular basis?

___________________________________________________________________

___________________________________________________________________

**General Ease of Use of the Digital Doorway**

1. Instructions about how to use the Digital Doorway are clear to me.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________
2. Instructions and information are given in various ways like written words, spoken words, and through pictures.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:

___________________________________________________________________

___________________________________________________________________

3. I can change the volume of spoken words and instructions to suit me.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:

___________________________________________________________________

___________________________________________________________________

4. Whenever I make a mistake, the Digital Doorway tells me exactly what the mistake is in a way that I can understand.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________
5. The Digital Doorway clearly shows me what I need to do next so that I can complete what I am doing.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

6. When I choose an item on the Digital Doorway, the information presented to me is what I expect it to be based on the title of that item.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

7. I understand the meaning of icons (pictures) used in the Digital Doorway.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
8. I am able to determine the meaning and purpose of signs and symbols used in the Digital Doorway.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

9. I am able to carry out similar activities in the same way in different parts of the Digital Doorway (For example, I can choose the language that I prefer in the same way).

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

10. The Digital Doorway contain words used by computer people which I do not fully understand

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
11. The Digital Doorway shows me how to correct my mistake.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

12. The Digital Doorway gives response within a short time.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

13. Spoken instructions and information are loud and clear enough for me to hear and understand.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
Ease of using the Registration form in the Digital Doorway

14. It is easy for me to determine which information I must give and which ones I may leave empty.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

15. The space provided is always sufficient for the information I need to write.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

16. I am able to determine where I should write information in the form.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
17. When I leave out information that is needed the Digital Doorway informs me about the missing information in a way that I can understand.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:

_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

18. It is easy for me to make corrections to information that I have written earlier without me having to retype all over again.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:

_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

**Usefulness of computer games in the Digital Doorway**

19. The Digital Doorway does not make fun of me when my answer is wrong.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:

_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
20. It is easy for me to choose in which language I want to play a game.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

21. The Digital Doorway informs what I should to in order to play the games.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

22. I am able to control how easy or difficult I want the game to be.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
23. It is easy for me to determine what the computer games in the Digital Doorway will be teaching me.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
</table>

Please write down any problem relating to the statement above in the space provided below:
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

24. Please write any other problem(s) you may have found while using the Digital Doorway in the space provided below.
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Thank you for participating in the evaluation of the Digital Doorway.
## Appendix F: Aggregate usability/accessibility problems and recommendations

<table>
<thead>
<tr>
<th>Heuristic category</th>
<th>Heuristics violated</th>
<th>Usability/Accessibility problems</th>
<th>Identified by (Evaluator)</th>
<th>Recommendations for Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Login Screen</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1.1</td>
<td>The benefit/use of creating a new user account as opposed to using the system as a guest is not clear. The login instruction is quite confusing, not sure how to handle the choice between creating a new user account and using the system as a guest.</td>
<td>E2; E4</td>
<td>1. Provide information that will assist users in making the decision of either to create a user account or use the system as a guest user. This is particularly important in the context of Internet access via GPRS using recharge vouchers</td>
</tr>
<tr>
<td>1</td>
<td>1.1; 2.3</td>
<td>Instructions for creating user account and for guest login are lumped together in the same text box.</td>
<td>E1</td>
<td>1. Separate the two instructions</td>
</tr>
<tr>
<td>1</td>
<td>1.2</td>
<td>After entering username, there is no indication of what to do next.</td>
<td>E1; E2; E3</td>
<td>1. Provide an &lt;Enter&gt; button next to username and password textboxes that can be clicked by the user. 2. Provide a prompt for the user to press the Enter button on the keyboard.</td>
</tr>
<tr>
<td>1</td>
<td>2.4</td>
<td>No option available to retrieve forgotten password</td>
<td>E2</td>
<td>1. The standard for system requiring username/password login is to have a mechanism for retrieving forgotten password</td>
</tr>
<tr>
<td>1</td>
<td>4.1</td>
<td>There is no feedback whatsoever when an incorrect username and/or password is provided.</td>
<td>E1; E2; E3; E5</td>
<td>1. Give explicit feedback that will enable users realize what their mistake.</td>
</tr>
<tr>
<td>1</td>
<td>2.1</td>
<td>After the acceptance of username and password, the message &quot;Language en_ZA.UTF-8 does not exist. Using system default&quot; was displayed.</td>
<td>E1</td>
<td>1. Use simple terms comprehensible to novice user.</td>
</tr>
<tr>
<td>3</td>
<td>1.1</td>
<td>The font sizes of the instructions on how to login/create user account in four other languages are small.</td>
<td>All</td>
<td>1. Provide login instruction in the predominant language for the specific area of deployment. 2. Consider an intelligent interface screen which will default to the preferred language of the user (selected at registration) following successful login using username/password 3. It would be good to have a language option selection button, and then have the instruction displayed in the preferred language 4. Increase the font size of these instructions</td>
</tr>
<tr>
<td>3</td>
<td>3.2</td>
<td>Background is colour too dark.</td>
<td>E5</td>
<td>1. Change to a brighter colour.</td>
</tr>
<tr>
<td>New Account Registration Form</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1  1.2</td>
<td>3.1; 3.2</td>
<td>There is no indication of which fields must be filled and which ones are optional.</td>
<td>E2</td>
<td>1. Clearly specify required and optional fields</td>
</tr>
<tr>
<td>1  2.1</td>
<td>The instruction/prompt ‘6 – 10 characters’ in the hint next to username and password data fields are technical and may not be understood by novice users.</td>
<td>E1; E2</td>
<td>1. Rather say ‘6 to 10 letters or numbers’</td>
<td></td>
</tr>
<tr>
<td>2  1.1</td>
<td>At the start of form application, the cursor is not positioned in the first data field. The user is required to place the cursor in the first field</td>
<td>E1; E3; E5</td>
<td>1. Provide a visible flashing cursor when the form is loaded in the first data field.</td>
<td></td>
</tr>
<tr>
<td>2  1.2</td>
<td>User cannot use the &lt;Tab&gt; key on the keyboard to select female for the gender field</td>
<td>E3</td>
<td>1. Allow the use of tab keys to move around form fields.</td>
<td></td>
</tr>
</tbody>
</table>

**Positive remarks regarding the registration form**
1. The provision of sample data expected for personal details is good.
2. The separation of personal details from user information is good.

<table>
<thead>
<tr>
<th>Main Desktop</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  1.1; 2.2</td>
</tr>
<tr>
<td>1  1.1; 2.2; 3.1</td>
</tr>
<tr>
<td>1  1.1; 2.2; 3.1</td>
</tr>
<tr>
<td>1  2.2; 3.1</td>
</tr>
<tr>
<td>1  2.2; 3.1; 9.1</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>1</td>
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<tr>
<td>1</td>
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<td>1</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>
### Other general comments on the Digital Doorway and content of main desktop

1. While there are excellent contents under <Programs> and <Resources>, however, the use of these resources is not promoted due to poor visibility. I had to discover these contents while trying to figure out how to exit the Digital Doorway.
2. There is lack of interactivity in the tutorials located in the icon labelled ‘?’
3. The tutorials are not learner paced.
4. No audio presentations for tutorials.
5. Some of the tutorials include elapsed time slide, which provides an indication how long the tutorial will take. However, other tutorials do not have the time slide.
6. Although the desktop interface is simple, the aesthetics could be improved.
7. The keyboard is quite robust and appropriate for environment of use.

<table>
<thead>
<tr>
<th>What-What Mzansi</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.</strong> 2.2</td>
<td></td>
</tr>
<tr>
<td>The functionality of the icon ‘?’ which provides context-specific instructions about the game, might not be adequately interpreted by some users.</td>
<td>E5 1. Provide a rollover indicating its function.</td>
</tr>
<tr>
<td><strong>1.</strong> 2.4; 2.5</td>
<td></td>
</tr>
<tr>
<td>The icon ‘&gt;’ within &lt;About&gt; menu option is typically used for forward progression, however, clicking on it takes the user back to the main screen of the game.</td>
<td>E5 1. Change this icon to the backward progression symbol ‘&lt;’ and provide a rollover to indicate this functionality. 2. Provide an option for users to go straight to play the game (If they so wish), rather than having to go back to the main screen.</td>
</tr>
<tr>
<td><strong>1.</strong> 4.1</td>
<td></td>
</tr>
<tr>
<td>The marks provided in “Total Score” and “Score” are different. This is confusing.</td>
<td>E4</td>
</tr>
<tr>
<td><strong>1.</strong> 4.1 2.1</td>
<td></td>
</tr>
<tr>
<td>The character reading out instructions and questions tells the user to answer yes or know, but did not tell him/her how to do this.</td>
<td>E3 1. The spoken instruction should also include a prompt to answer by clicking on either of the pots with the words ‘yes’ and ‘no’.</td>
</tr>
<tr>
<td><strong>1.</strong> 4.2 2.3</td>
<td></td>
</tr>
<tr>
<td>The countdown timer is not highly visible at its current location. This makes it difficult for users to know they are being timed.</td>
<td>E5 1. The timer is an important part of this game so it should be located at more prominent space to make it visible to users.</td>
</tr>
<tr>
<td><strong>1.</strong> 4.2 6.2</td>
<td></td>
</tr>
<tr>
<td>At the start of the application, some of the control buttons and the character that reads out instructions and questions are hidden from user’s view. A full screen mode of the application is activated by clicking arbitrarily around the taskbar.</td>
<td>All 1. The full screen view should be automatically displayed at the start of the application</td>
</tr>
<tr>
<td><strong>1.</strong> 9.1; 9.2</td>
<td></td>
</tr>
<tr>
<td>The label &lt;About&gt; is misleading. Evaluators were</td>
<td>E2; E4; E5 1. Provide clear instructions regarding the purpose of the game, how</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>4</td>
<td>2.1</td>
</tr>
<tr>
<td>3</td>
<td>4.1</td>
</tr>
<tr>
<td>3</td>
<td>5.3</td>
</tr>
<tr>
<td>4</td>
<td>6.2</td>
</tr>
<tr>
<td>4</td>
<td>6.1</td>
</tr>
<tr>
<td>4</td>
<td>6.1; 6.4</td>
</tr>
<tr>
<td>4</td>
<td>6.2</td>
</tr>
<tr>
<td>4</td>
<td>6.3</td>
</tr>
</tbody>
</table>
The browser close button. The <X> button, which presumably should close the game window, is not working.

| 4 | 7.1 | The game is only available in English | E1 | 1. Consider making the game available in other languages if possible. |

**Positive remark regarding What-What Mzansi**
1. The game is highly interactive. It is enjoyable.

### OpenSpell

| 1 | 2.2 | The use of the labels <Say>, <Guess>, and <Spell> are not descriptive of their functionalities. | All | 1. Use a more descriptive term |
| 1 | 2.2; 3.1 | The * symbols used to represent level of difficulty are not intuitive. | All | 1. Use descriptive terms which will enable users understand the functionality.  
2. Separate the language selection option from level of difficulty as two menu options. |
| 1 | 2.4 | The onscreen keyboard does not follow standard keyboard layout. | E2 | 1. Modify onscreen keyboard to follow standard keyboard layout. |
| 1 | 4.2 | When a correct answer is provided in <Guess> mode, the screen disappears very fast with no performance feedback. | E4; E5 | 1. Provide feedback that persists long enough for user observation.  
2. Consider providing clapping sound effects to acknowledge correct answer. |
| 1 | 9.1 | The menu labelled <Game> is being used for language selection options while another one which is appropriately labelled <Language> (suggesting that a user can select choice language) is greyed out. | All | 1. Change the label of <Game> menu to <Language>.  
2. Remove the greyed out items if the functions are not available for users to select |
| 1 | 1.1 | There is no instruction on how to play the game and use the buttons. | All | 1. Provide clear and easily accessible instructions on how to play and use the control buttons |
| 1 | 4 2.1 | The caption on the menu <About> is misleading. Was expecting to find instructions about the game here. | E4; E5 | 1. While the current content of is good, it should ideally be located at the Digital Doorway home page |
| 3 | 1.1 | The font size for menu palette at the top-left of the application window is small and somewhat hidden from the user’s view | E3 | 1. Increase the font size of the menu labels a little. |
| 3 | 1.5 | The quality of the speech output is poor and not easily discernible even when the volume is at maximum level. | All | 1. Improve the quality of the speech output |
| 3 | 2.1 | No visual feedback for correct/wrong answers in <Spell> mode. | E2 | 1. In addition to providing verbal feedback, also provide a thick mark to indicate correct answer and an X mark to indicate wrong answer |
| 3 | 5.1; 5.2 | The speed at which words are spelt by the voice ‘instructor’ is fast. A user cannot review previous spellings. | E5 | 1. Provide mechanism that will enable the user repeat previous spellings. |
| 3 | 10.1; 10.2 | When the <Spell> option is selected, the user cannot use the keyboard to provide input but must use onscreen keyboard. | E1; E2; E3; E4 | 1. Allow users to provide input via the keyboard in addition to using onscreen keyboard. |
| 4 | 4.3; 5.2 | There is no corrective feedback when wrong answer is given while playing in the <Guess> mode. | E5 | 1. Provide corrective feedback that will enable users learn from mistakes. |
| 4 | 6.1 | The user cannot control which words are spelt while using the <Say> option. The user cannot use the <Repeat> button if he wants the last spelt word repeated. | E1; E3; E4 |

**Themba’s Journey**

| 1 | 2.4 | When the mouse pointer is hovered on the speech bubbles, it changes to a hand with pointing finger. This is typically used to indicate a ‘clickable’ object | E3 | 1. Change to pointer with arrow head. |
| 1 | 8.1; 8.3 | Themba’s journey provides an <Exit> button to close application, while the same functionality is provided by the <X> button in What-What Mzansi. | E5 | 1. Be consistent in the way icons proving similar functionalities are represented |
| 1 | 8.3 | Language choice selection is via a menu in OpenSpell; however, the same action requires the user to hover the mouse over speech bubbles in Themba’s journey. | E1; E2; E3; E4 |
| 1 | 1.2; 7.2 | At each of the crossroads, there are no instructions on how make selection between available choices. Although information regarding this is provided under <Help> many users would have forgotten when users would have forgotten about the information when it is actually required. Rather provide a simple instruction on the same screen (for example, a prompting question asking “what...
<table>
<thead>
<tr>
<th></th>
<th>5.1; 5.2</th>
<th>8.2</th>
<th>1.4</th>
<th>Purpose of life skills tips might be missed by some users.</th>
<th>1. It might be worthwhile having another persona voice making explicit the importance of adhering to road safety rules. For instance, this can be done having the voice say something like “let’s go over the lesson we have learnt from the previous scene”.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 4</td>
<td>7.5</td>
<td>7.1</td>
<td>The backward/forward buttons disappears at the crossroads, making it difficult for user to review previous screens.</td>
<td>E2</td>
<td>1. Make all control buttons visible and accessible in all screens</td>
</tr>
<tr>
<td>4</td>
<td>6.2</td>
<td>6.3</td>
<td>The main &lt;Exit&gt; button does not close the application.</td>
<td>All</td>
<td>1. Correct the associated code that implements this button.</td>
</tr>
<tr>
<td>4</td>
<td>3.3</td>
<td>1.1</td>
<td>Long story. Require some time to complete.</td>
<td>E5</td>
<td>1. Provide a mechanism which keeps track of where the user temporarily stopped the application so he/she is not compelled to start all over again (at least for registered users).</td>
</tr>
<tr>
<td>4</td>
<td>1.4</td>
<td>1.4</td>
<td>The narration voice is only in IsiXhosa. Non-Xhosa users who cannot read cannot use the application.</td>
<td>E2; E3; E4; E5</td>
<td>1. Provide an English version of the program in speech in addition to text version</td>
</tr>
<tr>
<td>3 4</td>
<td>7.1</td>
<td>7.1</td>
<td>There is no audio equivalent for instruction in &lt;Help&gt;. The instruction in &lt;Help&gt; is provided only in English, not IsiXhosa, the default language.</td>
<td>E5</td>
<td>1. Make the instruction available in the default language as well.</td>
</tr>
<tr>
<td>3 4</td>
<td>7.1</td>
<td>1.4</td>
<td>To access an English version, the user must hover the mouse on the speech bubble. This is problematic for users with limited use of their hands. The instruction provided under &lt;Help&gt; did not specify this.</td>
<td>All</td>
<td>1. Provide an English version of the program in speech in addition to text version. 2. Provide a menu option from where the user can easily select language of choice.</td>
</tr>
<tr>
<td>3 4</td>
<td>7.1</td>
<td>1.4</td>
<td>Road safety information and other life skills tips is only available in text.</td>
<td>E2</td>
<td>1. Provide speech equivalent of the information in addition to the text.</td>
</tr>
<tr>
<td>3 4</td>
<td>1.2</td>
<td>1.4</td>
<td>The road safety information and other life skills tips are provided in English; however, the story line had consistently been given in IsiXhosa.</td>
<td>E2; E3; E4; E5</td>
<td>1. Be consistent in the way things are done. 2. Provide these information in IsiXhosa as well.</td>
</tr>
<tr>
<td>1 4</td>
<td>7.5</td>
<td>8.2</td>
<td>Some users might accidentally click on the &lt;Exit&gt; button.</td>
<td>E5</td>
<td>1. Provide a dialogue box where users can confirm whether they actually want to exit the program.</td>
</tr>
</tbody>
</table>
Positive comments regarding Themba’s Journey

1. The highlighting on the control buttons on being selected is good as this visibly show users that a button has been selected.

The New Username Selection Information Window (New interface, only used by E5)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.1</td>
<td>The use of the word ‘system’ in the sentence “A username is … to identify yourself on this system” is technical and might not be understood by novice users.</td>
</tr>
<tr>
<td>2</td>
<td>11.1</td>
<td>Cursor not in username field on opening the screen. The user has to place the cursor in the field.</td>
</tr>
<tr>
<td>3</td>
<td>6.1</td>
<td>Unspecific error message when an invalid character was included in username (Error message given is: “The username must be between 6 and 12 characters long”).</td>
</tr>
<tr>
<td>4</td>
<td>1.1</td>
<td>The use of the word ‘and’ in the hint “6 to 12 letters and numbers” might be interpreted as a mandatory requirement for password to include numbers and letters.</td>
</tr>
</tbody>
</table>