Appraising and Evaluating the Use of DAISY: 
A Study of a Reading Aid System

Miriam Nes
Avenir AS
miriam.nes@avenir.no

Kirsten Ribu
Oslo University College
kirsten.ribu@iu.hio.no

Abstract

According to the Norwegian Dyslexia Alliance (Dysleksiforbundet), serious dyslectic disorders occur in 5-10 per cent of the Norwegian population. In addition, several hundred thousand people have varying kinds of dyslexia. This means that print disabled students appear in almost every Norwegian classroom. In Norway, DAISY is used as a reading aid system for print disabled. DAISY is a system for producing, storing and playing digital books.

This paper speaks in particular to the community of DAISY producers, playback software developers and users. Its main goal is to highlight common user patterns and provide developers and producers with a map of which features in DAISY is used, how, and what should be considered core functionality based on user feedback. The study conducted in this work is limited to students in primary and secondary Norwegian education, but the method is described in detail to show that it may be used on other user groups as well.

The study reveals how and why DAISY is used within this sample. Quantitative data on system features, their importance and the quality of playback software help determine which areas of the DAISY system that need improvement. The paper further provides measurement scales for evaluation of system features. The results show that DAISY is useful for the target group. However, the needs of students with dyslexia or general reading and writing difficulties should receive more attention, especially regarding playback software.

Index Terms – DAISY, feature analysis, print disability, playback software.
**Introduction**

The focus of this paper is on the print disabled and their use of DAISY books. Dyslexic and print disabled people are often perceived as ‘information inhibited’. However, instead of denoting groups within society as information inhibited, one could as well view society as information inhibiting. Disability may be regarded as being contextual, therefore, removing designed obstacles means enabling the disabled. Print disability is defined as blindness, visually impairment, a learning disability such as dyslexia, or a disability that prevents physically holding a book [1].

In schools, printed information constitutes an obstacle for print disabled students, because it prevents them accessing information on the same terms as their fellow schoolmates [14]. Adaptations and adjustments of tests and exams in order to measure skills and achievements fairly are difficult [11] [12]. In Norway, disabled students who do not benefit from ordinary teaching techniques when compared to (a) their fellow students and (b) in relation to their individual potential, are entitled to adapted teaching [13]. Offering suitable learning tools ensures inclusion of and equal opportunities for print disabled in the educational system.

DAISY is an acronym for Digital Accessible Information System [41]. A DAISY book is a CD which can contain all or some of the following contents: Text files (xml, html), image files (for example jpg), and audio files (usually Mp3 or wav). A playback device is needed to ‘read’ a DAISY book, usually a special DAISY-player or playback software on a PC. The ease and efficiency of navigation is one of the key aspects of DAISY’s success [29] [39]. Another success feature is the storage; up to 50 hours of continuous speech may be stored on one CD. One DAISY book usually equals one CD, instead of seven or eight ordinary CDs. There are 6 types of books, defined by combinations of the contents [2]. When most or all of the contents of a book are represented by both text and audio files, the book is called a “full text” DAISY book (version 4).

This study seeks to reveal obstacles to the use and utilization of DAISY books and playback software, and provides suggestions to developers on how to improve the system. The study consisted of a survey, expert evaluation, interviews and feature analysis. Investigating the usefulness of DAISY is considered to have a certain social relevance. General access to printed information is a democratic issue. Up till now, studies of DAISY have been largely in-depth, examining the usefulness of the system from a pedagogical point of view, often focusing on emotional perspectives related to the use [3][4][5][6][15][16][42]. The results of such studies are textual and detailed, hard to translate into measurable and specific development issues, and not directly useful for the developers of DAISY software and book.

**The Daisy Project**

The DAISY Consortium was established in 1996. The aim of the international consortium was to (1) establish DAISY as a standard, (2) manage further developments - including playback tools, (3) manage the use and licensing of DAISY and (4) promote the concept. The focus is on offering the print disabled reader increasingly better products. On the first of May 2005 the Norwegian government supported the multi-organizational cooperative project ‘User
experience with full text DAISY books’ [17] was initiated. The aim of the project was to evaluate and develop methods and standards for producing full text books, and create guidelines for their use. Among the collaborators were the Norwegian Directorate of Education and Training, the University of Oslo, Huseby Resource Center and MediaLT, a company working to improve access for the disabled to computers and information. This work has been done in collaboration with the project and the DAISY community.

**Approach**

**Questionnaire Survey**

The survey as a method for collecting data on a software tool may be used when a tool has been used in an organization for a while [8] [20]. The DAISY system as a tool for reading has been used in the student population for several years. Two questionnaires were distributed to almost 600 schools – one targeted towards students, and another towards their teachers [18]. 566 schools are considered actual part of population. 130 students and 67 teachers replied, creating a sample of approximately 10 per cent of the population. The answers were analyzed using statistics and feature analysis.

Measuring the usefulness of DAISY included studying necessary functionality, performance, general usability and user attitude. Usefulness was measured in two ways: As experienced satisfaction and functional usefulness. User rating on advantages and utilization of the product was used in the questionnaires. The questionnaires were supplemented with usability tests and expert evaluation of playback tools, and were designed to answer the following questions:

1. **Who uses DAISY, and Why?**
   a. Who uses DAISY?
   b. Why is DAISY used?
   c. How is DAISY used?

The ‘who’ are the students and teachers in the sample. The question of ‘why’ is limited to the motivations for using DAISY. ‘How’ DAISY is used is mapped through studying frequencies and contexts of use, types of books, functionalities and playback devices employed by students, in addition to user training. Teachers are asked what type of DAISY book is chosen, and in which classroom context these are applied. The frequency of student use is specified by the number of times used per week. The term context means ‘physical place’ and ‘intention for use’ for students and for teachers ‘subject’ and ‘grade’.

2. **Is DAISY Useful?**

Is DAISY used: frequency of use based on age/grade, disability, subjects and gender?
Where is DAISY successful: experienced satisfaction related to the contexts of use?
Which features are used, easy to use (user friendly) and useful?
Are there any features lacking?
In the context of this study, measurements of usefulness should provide information for improving DAISY from a software development perspective. Therefore, the focus is on DAISY functionality – functional usefulness – over the solely emotional aspects of use – experienced satisfaction. The definitions of functional usefulness and experienced satisfaction in this study are as follows:
  o Functional usefulness is defined as the effectiveness and efficiency of DAISY functionalities. The effectiveness of DAISY was determined by asking if any features or functionality are missing in DAISY – i.e. if DAISY covers all desired aspects of use (question 2 d). Efficiency is defined as use and appreciation of the DAISY features, measured by the frequency of use and the assessed user-friendliness and personal benefit for each feature (Question 2 c).
  o Experienced satisfaction denotes the users’ subjective experiences of usefulness (Question 2 a and b). If users feel empowered, the tool provides a psychological benefit in addition to a certain utilization value.

Alternative definitions of usefulness can be found in [17] [21] [22] [23] [24].

**Survey Feature Analysis**

Two feature analyses were conducted in this study, first a survey feature analysis based on the statistical frequencies collected from the student questionnaire survey, and second an expert evaluation feature analysis [9]. The survey feature analysis was mainly applied in order to measure the overall usefulness of DAISY.

Four top-level features sets were defined for the survey: ‘Auditive’, ‘Navigational’, ‘Full text’ and ‘Bookmarks and notes’. These were expanded by more detailed features, shown in table 3. The importance of each specific feature in DAISY was calculated based directly upon the frequency of use of this feature by the respective survey respondents. 4 levels of importance were used, as recommended [8]: Features used by less than 25% were given the lowest importance ‘Nice to have’, assigned weight 1. Those between 25% and up to 50%, were assigned the next level ‘Desirable’, with weight 4. From 50% and up to 75%, ‘Highly desirable’ and the weight 6 were given. The upper most used features were given weight 10 and defined as ‘Mandatory’. No features were identified as being negative to the tool.

For each feature, points were assigned based on end-user survey ratings on ease and usefulness on a 5-level ordinal scale: -2, -1, 0, 1, 2. 0 indicates no reply (i.e. no impact on the score). The total score of each feature was then calculated by multiplying feature weight and the points assigned.

All feature scores from the forms in question were added together, first for each feature set and next for an overall assessment of DAISY. The assessment criteria were defined in the following manner, based on the percentage of total possible score:
  o Under 50% of possible score: Not accepted (meaning not useful)
  o 50%-75% of possible score: - Partly accepted (partly useful)
  o Over 75% of possible score: Accepted (useful)
Usability Tests

Student tests of playback software were performed to provide information about the feature requirements in playback devices [31] [32] and supplement the authors’ feature analysis expert evaluation. The commonly used DAISY playback software TPB Reader 1.01 [39] was compared to one of the mainly used licensed software, EaseReader 2.02. Usability testing has 5 characteristics: (1) The goal is usability improvement, (2) testers are real users, (3) testers perform actual tasks, (4) observation and documentation of what testers say and do, (5) data analysis, problem identification, and recommendations made [7]. The software user interfaces were evaluated based on Human-Computer Interaction design principles and accessibility issues [25] [26] [27] [28], with focus on interaction and user interface design.

A history book in Social Science for 10th grade students [10] was chosen as the test-case DAISY book, as the content was perceived to be gender neutral, of general interests to the students and to fit the level of knowledge of the testers. Usability tests were conducted using cognitive walk-through with ‘think aloud’ technique and observations using both human observation and Camstacia – a video capture system. Six 9th grade students were given real user school tasks. Interviews with five of the students were conducted using the laddering technique [29] [30]. Laddering is performed by using probing questions, and aims at revealing the values and motivations by dislikes/likes of certain software or product attributes. The results are hierarchical value maps (HVMs), linked or separated and specifically tailored to the desired level of information and the point of view, presenting the interview results visually.

Feature Analysis Expert Evaluation

The expert evaluation measures the usability of software features related to user needs. Each feature and feature set to be evaluated is assigned an importance based on user requirements. The overall software usefulness evaluation was based on the accepted implementation of Mandatory feature sets.

The criteria for selecting software were: 1) Is the tool heavily used, or is it likely to soon become heavily used? 2) Does it have full text functionalities? and 3) Does the tool include Norwegian languages? Amis 2.5, EasyReader 2.30 (name change due to newer version) and Victor Reader Soft 1.5 were chosen. TPB Reader had serious stability issues during the student tests and was omitted in the expert evaluation.

Three categories of features were defined: Supplier, Usability and Functionality [33] [34] [35] [36] [37] [38] [40]. Within each of the categories, general feature sets to be assessed was formulated, such as ‘User Interface’ and ‘Navigation Features’. These feature sets consist of more specific level 3 features, for example ‘robustness/stability’ and ‘jumping between chapters’. Thus, the features form a tree-structure.

Feature sets were assigned importance using the recommended 4 level importance scale from Mandatory to Nice to have. Each feature set was evaluated as either ‘Excellent’, ‘Above average’, ‘Below average’ or ‘Lacking’, and based on this given scores on a scale from 1 to 4,
4 being the top score. Level 3 features were assessed as either Support or Important. Since nominal features, a 4 was given for present, and a 1 was given for non-present.

The criteria for an accepted tool for the user group in question, was that all Mandatory feature sets were acceptably implemented. The acceptance of a feature set depends on the acceptance of its level 3 features. For level 3 features, Important features were defined as acceptable if 'Above average' or better, and for a Support feature the acceptable score was 'Below average' or better. Likewise, while Mandatory sets had to minimum meet the criteria of being ‘Above average’, sets with lower importance were accepted at somewhat lesser implementations.

As an example showing the criteria for acceptance – the base for the evaluations – is the definition of ‘Above average’ for features and features sets. For level 3 features: “The feature is easy or fairly easy to find and is at least fairly intuitive and well-designed. The feature is either: – Implemented in a non-standard manner, that is considered unfamiliar to the common user, or – Not giving satisfying and well-formulated feedback, or – Is less usable without visual feedback, or – Is implemented in only one manner where several would have been preferred (some simplification) and also have no extra functionalities.”, and for feature sets: “The inclusion of features is satisfactory, but not all features are easily used. Some vital drawbacks in the implementation exist – i.e. some of the level 3 features considered important do not meet an acceptable threshold.” Details on all four criteria levels for both level 3 features and feature sets may be found in Nes [19], along with more details on feature analyses.

Results

In this study, the user subgroups within the Norwegian school system were established as:

- Student users are mainly 13 to 16 years and in 7th to 10th grade - i.e. largely in the lower secondary school.
- Around 90% of the students have non-visual print disabilities, such as dyslexia or general reading and writing difficulties.
- About 2/3 of this user group are male students.

The students’ main responses for using DAISY were that it makes reading easier, improves understanding of text, helps them remember more and work more efficiently. The survey shows that being able to work independently is not a main motivation for using DAISY. Teachers mainly use DAISY because their students have reading problems. In other words, the focus is on reducing their students’ disabilities, instead of appreciation and knowledge of DAISY attributes. DAISY is found to be mostly used in social studies and oral subjects as well as nature- and environmental studies. The highest rates of successful deployment are given to social studies and oral subjects. 90% use DAISY at home, for homework and school assignments. In addition, about 1/3 use DAISY at school. The use of DAISY is almost exclusively for homework and educational purposes.

User training

The survey shows that 90% of the teachers do not receive any user training. Only about half the students receive guidance. No connections are found between the use of features,
assessment of ease of use and user training. There are no differences in the evaluated ease of use of DAISY functionality between students who have received help and those that have not. This indicates that the training and help received by the students does not make DAISY easier to use - i.e. students obtain the same knowledge of DAISY functionality when exploring the playback tools on their own. A preliminary explanation was that the DAISY system is so user friendly that training is superfluous. The ease with which student testers used navigation features in EaseReader shows that it is not overly ambitious to expect users to understand the basic use of navigation in DAISY, even when they have no prior knowledge of the structure of a DAISY book. DAISY is perceived as useful even without user training.

Features in full text DAISY

12 students using full text DAISY were asked if they experienced any lack of functionality. 1 student requested features that already exist and 1 wanted existing functionality to be easier to use. The rest either replied ‘no’ or did not reply at all. It is therefore fair to say that users do not feel that DAISY lacks desirable functionality. The teacher assessments of how successfully DAISY deploys in classroom use were: ”Very well” in 43 classes (24%), ”Fairly well” in 88 classes (48%), ”Fairly badly” in 33 classes (18%), ”Very badly” in 5 classes (3%). When asked what they like about full text DAISY compared to other book formats, 5 students replied ‘that one does not have to read oneself’. 1 did not reply and the 7 other students all answered differently, only 1 of which mentioned ‘reading text on computer screen while listening’. When asked what they don’t like, 2 students focused on technical problems (i.e. the playback software) and 2 more felt it was too hard to use. 3 students did not answer the question and the other 5 all differed. Because of a low number of full text users and a large spread in their replies, the information is not representative.

Emotional Satisfaction

DAISY is evaluated as emotionally satisfying. Almost half the teachers found DAISY to work ’fairly well’. In addition, 1/4 found that it worked ’very well’. Twice as many of the teachers had an overall positive attitude towards DAISY, compared to those more negative. Almost 1/3 of the teachers said DAISY is efficient in use, emphasizing the navigation. Other common, open answers were: ‘DAISY is easy to use, makes it easier for the student to work independently, and helps the students to learn’.

Functional Usefulness

The overall functional usefulness for DAISY was given a 72% share of the total possible score. Since the threshold was set at 75%, see section X, this means DAISY is measured to be ”partly acceptable” when it comes to functional usefulness - although it should be noted that it was generally very close to being accepted as functional useful. Some users give DAISY excellent scores, others are more critical.
When looking at the 4 survey feature sets, Navigational features are mainly accepted (3 out of 4). Half the full text features are accepted. No features are ‘not acceptable’ - i.e. all features are considered to be easier to use rather than hard to use, and more useful than not useful.

**Survey Feature Acceptance**

11 out of 17 features are ‘partly acceptable’, and Bookmarks and Notes functionalities are close to non-accepted thresholds. The 11 partly acceptable features may be split into three groups: 1) Those that are very close to being accepted, 2) those closer to being assessed as non-acceptable, and 3) those that are somewhere in between.

Many audio features are nearly acceptable. The main problem is that audio features are hard to use. The composite ‘Narrator’ feature and the ‘Listening to synthetic speech’ are nearly accepted if synthetic speech is improved. The two partly accepted full text features have low points both on ease and usefulness. All bookmarks and notes features have low ease and usefulness points in addition to being used by few, and must therefore be regarded as nice-to-have features. Hardly anybody uses them. Almost all navigation features are acceptable. There is a large spread in features that are used. No vital features are missed by the students. A human narrator is considered much more useful than a synthetic, even though the students are fairly satisfied and familiar with synthetic speech. Because of production time and costs, a trade-off is necessary between full text and natural audio.

<table>
<thead>
<tr>
<th>Auditive functionalities</th>
<th>Partly acceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrator (composite)</td>
<td></td>
</tr>
<tr>
<td>Listening to natural speech</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Listening to synthetic speech</td>
<td>Partly acceptable</td>
</tr>
<tr>
<td>Adjustment of speed of speech (composite)</td>
<td>Partly acceptable</td>
</tr>
<tr>
<td>Adjusting the speed of speech to be slower</td>
<td>Partly acceptable</td>
</tr>
<tr>
<td>Adjusting the speed of speech to be quicker</td>
<td>Partly acceptable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Navigational functionalities</th>
<th>Partly acceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jumping between or to chapters</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Jumping to a specific page</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Leafing from page to page</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Jumping backwards or forwards in time</td>
<td>Partly acceptable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Full Text functionalities</th>
<th>Acceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using full text on screen</td>
<td></td>
</tr>
<tr>
<td>Using text search (search functionality)</td>
<td>Partly acceptable</td>
</tr>
<tr>
<td>Adjusting the text size</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Adjusting interface colors</td>
<td>Partly acceptable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bookmarks and Notes functionalities</th>
<th>Partly acceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creating bookmarks</td>
<td></td>
</tr>
<tr>
<td>Creating textual notes</td>
<td>Partly acceptable</td>
</tr>
<tr>
<td>Creating auditive notes</td>
<td>Partly acceptable</td>
</tr>
</tbody>
</table>

Table 1: Summary of Final Feature Analysis Survey Calculations

A Discussion of DAISY Features and their Importance
The features that are used by the most students are: listening to audio (usually natural speech), jumping to a specific page, jumping to or between chapters, leafing through the book page by page, and adjusting the narrator (either quicker or slower). Not all the features implemented in the DAISY standard are used, and are therefore not considered necessary and useful. Some of the features that were believed to be important and useful are judged as partly accepted and not accepted. Table 1 shows the results of partly accepted features grouped by frequency and ease of use and the feature analysis.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Used By (relative to level)</th>
<th>Ease</th>
<th>Usefulness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creating textual notes</td>
<td>Few</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Creating auditory notes</td>
<td>Few</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Jumping backwards or forwards in time</td>
<td>Few</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Adjusting interface colors</td>
<td>Few</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Adjustment of speed of speech (composite)</td>
<td>Few</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Using text search (search functionality)</td>
<td>Many</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Creating bookmarks</td>
<td>Many</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Adjusting the speed of speech to be slower</td>
<td>Many</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Listening to synthetic speech</td>
<td>Many</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Adjusting the speed of speech to be quicker</td>
<td>Many</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Narrator (composite)</td>
<td>Many</td>
<td>Medium</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Table 2: Partly Acceptable Features based on Categories of Use

**Evaluating DAISY Playback Software**

The survey shows that the by far most commonly used playback device is freeware. Some also use licensed playback software.

In the student usability tests, none of the testers used the help manuals available, although they struggled to solve tasks. Thus, necessary information for an effective use of DAISY must be available in the interface, for example through “mouse over” and textual explanations of icons. Both EaseReader and TPB Reader lacked information on the possibilities in the menus, and this lead to less efficient interaction.

During observation a major stability difference was found: EaseReader worked as expected, whereas TPB Reader crashed twice for the first tester, and once for the second. The reason for TPB Reader’s instability and crashing seems to be slow response time combined with a non-familiar interface. The observations revealed extensive mouse clicking in the TPB interface, and this seemed the reason why TPB Reader suddenly crashed without warning.

EaseReader testers described a situation where non-efficient design, frustrations and disturbed concentration lead to reduced learning. It became clear from the interviews that efficiency was the vital attribute for the students, supporting each of the higher motivations for using DAISY.
DAISY. However, although reduced efficiency of navigation was important to the students, it cannot compare to the seriousness of TPB Reader’s instability.

No gender differences were observed during the tests, neither did the interview data support any such assumption. Table 1 summarizes main findings from the usability tests.

<table>
<thead>
<tr>
<th>Area</th>
<th>EaseReader</th>
<th>TPB Reader</th>
</tr>
</thead>
<tbody>
<tr>
<td>Navigation</td>
<td>Hard to find functionality</td>
<td>Hard to use functionality</td>
</tr>
<tr>
<td>Bookmarking</td>
<td>OK</td>
<td>Not useful</td>
</tr>
<tr>
<td>Vital issue</td>
<td>Scroll problem</td>
<td>Instability</td>
</tr>
</tbody>
</table>

Table 3: Summary of Student Usability Test Main Findings

The expert evaluation revealed that the freeware Amis suffer from a similar instability issue, and because of this, it seems it is not the most usable tool for the students, although it is the only software that fulfills the criteria for acceptance of all the 'Mandatory' feature sets. Table 2 displays the scores on the different feature sets for each software, as well as the total software score. In short, the students are have to choose between a stable tool that have graphical user interface design and behavior lacking for visual users (EasyReader 2.3), and an unstable tool that are otherwise fitting (Amis 2.5).

<table>
<thead>
<tr>
<th>Tool</th>
<th>Total Score</th>
<th>Average Total</th>
</tr>
</thead>
</table>

Table 4: Comparing the Feature Set Scores of the Playback Software

Navigation - The Main Feature Set

The navigational feature set is considered the main set contributing to the usefulness of DAISY. Almost all navigational functions are used by most of the students. The functions also received acceptable scores in the feature analysis. The navigation features considered particularly important are ‘jumping to or between chapters’ and ‘jumping to a specific page’. In the analysis, the latter received the highest score and jumping to chapters came close. Both features belong to the core features.
Auditive Learning

Listening to a narrator is perceived as a base functionality in DAISY. This is reflected by the feature analysis, where the feature ‘Listening to natural voice’ was rated as important and received high scores. ‘Listening to synthetic voice’, on the other hand, was rated lower as to importance and scores, and only nearly accepted. About 90% of the students found (digitalized) natural speech useful, compared to 70% who found synthetic speech useful. 79% found natural speech easy to understand, and 74% found synthetic speech easy. Natural speech is clearly preferred to synthetic speech.

Full Text Features

The majority of both students and teachers have only used original audio books. A feature set that is not used cannot be considered to be helpful. This finding generated several working hypothesis as to why full text functionalities were not used.

One of the reasons was assumed to be that the full text use requires user training. With this assumption, students that have used full text should have received training. This assumption was tested by comparing reported user training to full text usage (represented by the main full text feature – ‘Using full text on screen’ – referring to watching the book text on a computer screen). However, of the 8 students that had tried the feature, none had received user training. The students came from 5 different schools. None of the 8 teachers from these schools had received training either, and only 1 of the 8 teachers said his/her student(s) received training. Thus, the assumption was not contradicted.

When cross-checking with the numbers of full text DAISY books produced up until the survey, the reason for the low use was revealed: Full text is rarely used mainly because there are few full text books available. When comparing the percentage that has used full text in the sample (11%) against the share of full text books available (0.5-0.7%), the main producer of DAISY books in Norway – Huseby Resource Centre – was actually surprised by the “high” share of full text users.

With this, numbers of use were adjusted for full text feature, and two full text features were accepted: ‘Using full text on screen’ and ‘Adjusting the text size’. The other two full text features, ‘Adjusting interface colors’ and ‘Using text search’ were only partly acceptable. Especially searching for keywords was found to be little used, and was assessed as non-important.

Bookmarks and Notes - Superfluous Features

Bookmarks and notes features were close to non-acceptance – receiving scores just over half of the possible total (under half would be a negative score). Users of the features rate the functionality low on ease and usefulness. Very few use the features.
Core Functionality

Core functionality is defined as those features that are considered to be basic and vital, have received scores high enough to be accepted or nearly accepted, and in addition are used by a majority of the students. The core features in ranked order of importance are: Scrolling, jumping to a specific page, jumping to or between chapters, using full text (text on screen), listening to natural speech, and listening to synthetic speech. The core features were defined by studying the frequency of use, user satisfaction and the scores from the feature analysis. Only those features that received high enough ratings to be accepted or nearly accepted were considered. The core features, in ranked order – reflecting their importance for the students - are shown in table 5.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Importance</th>
<th>Overall Ease</th>
<th>Overall Usefulness</th>
<th>Overall Accepted</th>
<th>FW Ease</th>
<th>FW Usefulness</th>
<th>FW Accepted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scrolling</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Jumping to a specific page</td>
<td>10</td>
<td>1.31 P</td>
<td>0.99 P</td>
<td>Yes</td>
<td>1.05 P</td>
<td>1.37 P</td>
<td>Yes</td>
</tr>
<tr>
<td>Jumping to or between chapters</td>
<td>10</td>
<td>0.84 P</td>
<td>1.2 P</td>
<td>Yes</td>
<td>0.87 P</td>
<td>1.26 P</td>
<td>Yes</td>
</tr>
<tr>
<td>Using full text on screen</td>
<td>3</td>
<td>0.65 P</td>
<td>0.5 P</td>
<td>Yes</td>
<td>0.67 P</td>
<td>0.6 P</td>
<td>Yes</td>
</tr>
<tr>
<td>Listening to natural speech</td>
<td>10</td>
<td>0.96 P</td>
<td>1.15 P</td>
<td>Yes</td>
<td>0.94 P</td>
<td>1.21 P</td>
<td>Yes</td>
</tr>
<tr>
<td>Listening to synthetic speech</td>
<td>3</td>
<td>0.42 P</td>
<td>0.27 P</td>
<td>Nearly</td>
<td>0.43 P</td>
<td>0.25 P</td>
<td>Nearly</td>
</tr>
</tbody>
</table>

Table 3: Ranked Core Features (P=average points, FW=Freeware)

Suggested Improvements

The DAISY standard embeds a wide range of features. However, this study shows that less than 50% of the features are used. The six features outlined below represent the most essential needs of the largest by far student user group – namely students with dyslectic disorders. These features may therefore be interpreted as core functionalities in DAISY:

1. Scrolling
2. Navigating to a specific page
3. Navigating to or between chapters
4. Using full text (viewing the book text on screen)
5. Listening to a natural narrator
6. Listening to a synthetic narrator.

In addition to these core functionalities, ‘Leafing from page to page’ and ‘Adjusting text size’ were features receiving high score values in the sample – and assessed as acceptable (useful).

DAISY was developed with the base features of audio and navigation in mind, and these are still the core of DAISY usefulness. With the growth of a visual user group, full text could be regarded as a new base feature set. Thus, listening to synthetic speech is increasingly important, as full text features are becoming the default standard. These features should therefore be given the main focus in future development of the system.

The limited knowledge of the importance of full text – due to limited availability and use – makes it difficult to decide which is more useful: audio quality or full text format. For older students (secondary school), full text is generally considered to be more important than natural speech, since a majority of the students are non-visual print disabled. On the other hand, images and illustrations could be used instead of a large text body for young audiences, along with natural, engaging voicing. Also, some of the graphical user interfaces are developed with visually impaired users and developers in mind, instead of visual print-disabled users. More attention must be directed at improving the interfaces of the playback software, and to the efficiency of the system.

It is considered far more appropriate to improve the implementation of the six identified main features with regards to learnability and robustness, than it is to keep broadening the DAISY standard. Despite pedagogical reasons for including more features, and the wish to be usable to all, simplicity in design might be better. Playback device developers could also implement fewer features, and focus more on stability. It is important to keep in mind that the main users are dyslectic children who receive no systematic training, and who have only a 50% chance of being guided by a non-trained grown-up with limited knowledge of the system. If the basic functionality can be learned easily and utilized through the interface, the usefulness of DAISY will increase. This will also make the students less dependent on their surroundings.

**Conclusion**

The development of the DAISY books started out as an auditive book format with largely improved navigational structures. The members of the DAISY Consortium have focused mainly on visually impaired users, whereas organizations for physically handicapped and dyslexic have been less involved. As this study shows, the main user group has non-visual print-disabilities, and a gap is apparent between those who the DAISY software is developed for, and the actual majority of the users.

The overall conclusion is that DAISY is quite useful for dyslectic students, considering both functional usefulness and emotional satisfaction. The feature analysis survey seems to correctly assess how usable DAISY is as a tool for reading in a specific user population. The student respondents must be considered frequent users, and the level of knowledge they have achieved using DAISY should be considered high. DAISY is used several times a week for homework in social studies in the lower secondary grades, the students work unsupervised at home having received little or no user training, using free playback software and a DAISY
audio book, listening to and adjusting the narrator while navigating through pages and chapters. Even if one does not totally agree with the score systems and analysis process of the two feature analyses, the results may be used as a comparison of features. The results correspond to related research, which shows that using DAISY helps non-Visually print-disabled students to learn on the same terms as their non-print disabled classmates [4][5]. This is agreed on by parents, students and teachers. Thus, DAISY lessens the digital divide in education.

The training received is not adequate for efficient use of DAISY. This might explain why so few features are used, even though students and teachers concur in reporting that 50% of the students have received user training. However, another explanation should also be considered: Not all the features implemented in the standard playback tools are necessary.

DAISY is now evolving into integrated audio and visual books,”full text” DAISY, suited for a larger market. Full text DAISY is said to be a universally designed product, since it can be read by non-impaired, visually impaired, hearing impaired, kinetic hindered, dyslectic and users with other reading difficulties. The Consortium also seems to aim at promoting DAISY as universally designed. This is a paradox if the real usefulness of DAISY is found in a few basic features, and the learnability and stability of playback software. The attention should therefore concentrate on improvements related to the needs of those users who already prefer DAISY to printed text. Instead of adding new features to the standard, improved implementation of existing features, especially of the six core features, should be considered. For further improvements, focus should be on the robustness of the free playback software, and on the learnability and usability of the software interfaces.

References