1 Introduction

This contribution will provide an overview of the essential role played by design in both the form of dictionaries and their usability, as well as examining the different traditions which exist in the design of (print and electronic) dictionaries (Section 2.1). The development of dictionary design depends on the intended context in which the dictionary will be used, its potential users and its data modelling (Section 2.2). Usage studies (Section 3) can help to look further into user needs concerning dictionary design. The design practice is dependent on a number of elements which are not unique to dictionaries, but also on many dictionary-specific factors: for example, whether the dictionary is a retrospective digitalization project or whether the design takes as its starting point the content of the dictionary or its intended users (Section 4). Search functionality is what provides access to an internet dictionary, so that its design also has to be planned carefully (Section 5). Finally, the role of established design frameworks in the design process will be considered, including how templates are employed and how the lexicographical process should be informed by the interconnected development of content and design (Section 6).

In this way, design is much more than mere aesthetic eye candy, added on top of the core conception of the dictionary. The design of practical everyday objects, including tools like dictionaries, involves a wide range of aims and requirements. As such, functional, economic and aesthetic factors all need to be taken into account, and even psychological aspects, such as the emotions that users associate with the object. In this context, design means developing the best possible solution for a product so that these potentially competing requirements are assembled into an effective whole.

2 General thoughts on the design of (internet) dictionaries

2.1 Similarities and differences between print and online design

Print dictionaries are created according to the principles of graphic design, where typography plays the most important role. There are familiar design elements for print dictionaries which have, in some cases, been handed down over many hundreds of years: the alphabetical order of the headwords, which appear in bold at the beginning of the entry; the layout of the headwords in...
columns (usually two per page) or the indication of the range of entries on a page through column headings at the top of that page. Here, it has always been a problem that the print space has to be used as economically as possible, leading to high text-density and making reading more difficult. For this reason, design decisions for print dictionaries mostly seek to achieve a balance between the need to present the text in a readable manner and the need to optimize use of the limited print space. In the online medium, different conditions tend to apply, so that different design decisions can be reached.

Website content is described in a hierarchically structured fashion using HTML (Hypertext Markup Language), which a browser converts into the desired form of presentation. In the early years of the worldwide web, HTML left it to individual browsers to determine how particular elements, such as text, were represented, so that the design of websites left much to be desired. Nowadays, the combination of HTML and cascading style sheets (CSS) gives web developers greater control over the design of their websites, as CSS defines their graphic style, colour, and animations, as well as the layout for printing or for small screens. Recent enhancements, such as web-fonts and rules for complex grid layouts, mean that HTML and CSS come close to print in the possible forms of representation that they offer. However, this wide range of possibilities also brings with it the need to use them correctly. As such, the demands placed on web designers' skills and the resources that need to be invested in the design of dictionaries have also increased.

In the digital medium, the new aspect of user interface design, or application design, adds a further element to the design of the text itself, including the wide range of interactions that users have with a dictionary website. For example, internet dictionaries contain links (the defining characteristic of hypertext), and they have a number of standardized interactive elements, such as buttons, text fields or menus (all of which are already included in HTML to create simple forms of input). Finally, JavaScript makes it possible to make dynamic changes to the content of websites and to develop particular components (also known as widgets), such as tabs and menus, which are not included in the HTML standard. This facilitates complex interactions between users and internet dictionaries. If these are implemented correctly, then users do not have to learn specially how to look things up or how to navigate in an internet dictionary. Rather, the dictionary 'functions' in the same way as other websites and applications.

At its best, therefore, the design of digital dictionaries draws on both traditional graphic design and user-interface design from the field of software development. Depending on how interactive the design for an internet dictionary needs to be, a greater or lesser number of application design elements can be incorporated. Here, the dictionary text and its word entries undoubtedly remain at the centre of the overall design, but complex, dictionary-specific components can be designed in the application around that text, such as headword lists, indexes, extended search functions or data visualizations.

2.2 Design dependencies

In all design decisions, it is possible to distinguish three sets of dependencies for web design: first, on the context in which an internet dictionary is used; second, on the form of modelling chosen for the dictionary data and, third, on the dictionary's users.
2.2.1 Context of use

In the case of a stand-alone dictionary, design decisions are, of course, more independent than if it is part of a dictionary portal or if it is embedded in another application, such as a text editor or a language-learning platform. In these cases, the design standards from the environment in which the dictionary is embedded must first be implemented. In the most extreme cases, the dictionary in its own right may disappear almost entirely from the user interface and is visible only, for example, in a text editor through the wavy underlining of an incorrectly spelled word and the suggestion provided for how the word should be spelled.

A dictionary intended to be used on a mobile device is subject to different constraints than a dictionary for a desktop browser. This includes not only the space available on the screen where the dictionary content is to be displayed, but also a variety of control elements. While the mouse can be used in a desktop browser, navigation on mobile devices works by touching the surface of the screen with a stylus or with your fingers. For example, controls on mobile pages have to be designed to be large enough to allow them to be operated reliably and, of course, some functions, such as 'mouse-over' effects, are absent altogether from mobile sites. While mouse clicks are undoubtedly the primary form of interaction for desktop browsers, mobile platforms offer a wider range of navigation gestures, such as swiping or pinch and zoom. Location and light conditions also have a role to play. For example, an internet dictionary which is to be used primarily outside, on a smartphone, in glaring sunlight, has to use contrast differently to one which is used mostly in indoor spaces. For this reason, many websites now have two design variants — a light mode and a dark mode — and allow the user to adjust them accordingly.

2.2.2 Data modelling

Naturally, the structure of the dictionary content itself has a decisive effect on design. A fundamental distinction exists between textual data and structured data. Textual data consists of continuous discursive, narrative, or argumentative text in natural language (in contrast to formal language). In addition, this form of data may contain an internal informational structure, distinguished in semantic terms (e.g. headings, quotations, references). By contrast, data structures or records consist of pairs of so-called keys and values: in the context of dictionaries, for example, these records consist of the ‘lemma’ and ‘word class’ keys or of the lemma values hand, run, diligent or you and the word-class values noun, verb, adjective, pronoun and so on. These pairs of keys and values can be assembled into groups or objects, combined into more complex structures in trees and lists, and stored in databases.

In XML (Extensible Markup Language), which is the most common metalanguage in lexicography, structured textual data is also referred to as ‘mixed content’. Keys correspond to the names of elements or attributes and values to the specific values of the elements or attributes. In most cases, dictionaries are characterized by hybrid forms of textual and structured data: i.e. data structures containing additional information (e.g. metadata) may be embedded in the text. These embedded data structures might also break down information that is formulated in a dictionary text into a formal representation, or model, which can be understood by a computer. Conversely, data structures may be supplemented by textual data, for example, in the form of detailed commentary fields.
As far as textual data is concerned, the emphasis in design rests primarily on typography and legibility. For data structures, the design often reflects the tree structure of the data in list-form or in a hierarchically organized form, reminiscent of a table of contents. However, data structures can also be presented in a form similar to continuous text, for example, when entries from a list are arranged one after another in the same line, separated by commas. In any case, planning the graphic display of the dictionary data itself in the design of internet dictionaries involves combining both principles (continuous text and structured text) in a manner appropriate to the data, the context of use, and the user.

2.2.3 The user

Focusing on the user in the design process — in other words, user-centric or human-centric design — has its origins in industrial product design and follows the well-known principle that ‘form follows function’. Applied to the use of a dictionary, this means that the elements in the dictionary and its content are organized and designed in such a way that the user is able to successfully look up what they need to, while expending the minimum possible time and cognitive effort. If the user is to be the starting point for design decisions, then naturally a number of questions have to be answered. For example: Who is a (typical) user? Which problems do they typically want to solve? What is the (typical) search behaviour adopted to answer the problem? We can begin to answer these kinds of questions through so-called ‘user stories’. These are case study scenarios involving fictional users (who are conceived in as concrete and realistic a way as possible), which give designers a framework for the development process. User testing and dictionary usage studies (cf. Section 3) can then be employed to establish how effective these scenarios and planning strategies prove themselves to be in reality.

By contrast, many internet dictionaries nowadays continue to adopt a content-centric approach to design; that is, they list their information in a more or less condensed fashion, organizing it according to their internal structure (which is primarily motivated by lexicological or lexicographical principles). As such, it is left to the unspecified user to extract from the internet dictionary the information relevant to them in a particular situation. This is particularly the case for general monolingual or multilingual dictionaries which are not integrated into other applications. However, if a dictionary is embedded in an application and a specific context of use, then, as one would expect, the user and their aims should exert a strong influence on the design. Unfortunately, embedded dictionaries and those intended for specific purposes have tended to play a lesser role in academic lexicography up to now.

3 Usage studies on design

Although there is now a relatively long tradition of research into the use of print and internet dictionaries (see Nesi, Chapter 5), there are not many usage studies which deal specifically with questions of design. Hitherto, research in metalexicography has also not tended to concentrate on design issues for internet dictionaries. Publications by Almind (2005), Debus-Gregor and Heid (2013), Oppentocht and Schutz (2003), Spohr (2008) and Swanepoel (2001) have focused on the connection between the modelling of data and its online presentation. Studies by Corréard
(2002), Hollós (2018), Lew (in press) and Schmitz (2016) looked, above all, at the arrangement of the lexicographical information on the screen. Other researchers, notably Dziemianko (2014, 2015 and 2016), have examined the positioning of particular kinds of information or the use of colour. Finally, Storjohann (2018), Tomer and Arias-Badia (2019) and Michaelis, Müller-Spitzer and Wolfer (2019), among others, have concerned themselves with possible new forms of data presentation.

Usage studies on internet dictionaries in the form of eye-tracking experiments have been undertaken notably by Lew (2010), Lew et al. (2013), Lew and Tokarek (2010), Nesi and Tan (2011) and Tono (2000 and 2011), while Müller-Spitzer, Michaelis and Koplenig (2014) used this method to test a new design for a dictionary portal. Heid and Zimmermann (2012) propose usability testing as a method to develop the design of internet dictionaries, and Koplenig and Müller-Spitzer (2014) outline the results from a usage study on a variety of possible forms of data presentation.

Figure 24.1a Heat-map of participants in an eye-tracking study scanning the OWID website as a whole (Müller-Spitzer, Koplenig and Michaelis 2014: 724).
Eye-tracking studies, in particular, make it possible to assess in detail whether the arrangement of information on the screen, the typographical design, and the use of colour, etc. are understood in the given situation by the study participants in the way that was planned and whether they are used by them to orient the way they look at the screen. The heat-map in Figure 24.1.a illustrates that participants spent time looking at all the parts of the website when they were given the task of familiarizing themselves with the OWID dictionary portal; Figure 24.1.b demonstrates that, when asked to find out which dictionaries are combined on the portal, participants’ attention lingered above all on the list of these resources. Thus, the design developed for the dictionary portal is successful in helping the user to orient themselves between the different kinds of information.

Figure 24.1b Heat-map of participants in an eye-tracking study scanning the OWID website for all dictionaries included (Müller-Spitzer, Koplenig and Michaelis 2014: 724).
4 Design practice for internet dictionaries

4.1 Design fundamentals

If we view internet dictionaries as a subset of websites more generally, then the design options and rules that have been developed in this field will also apply to them. For designers of internet dictionaries, this has the crucial advantage that they can draw on a breadth of existing design practice and experience. As explained in Section 2.1, web design is influenced by print and graphic design and their traditions that reach back centuries. This should not surprise us: for all that our technology and media might have changed, humans' cognitive capacities in the way they interact with text and image cannot have changed in any fundamental way in what is, in evolutionary terms, a relatively short period of time. Something which was easy or difficult to read 200 years ago will continue to be so today.

It is beyond the scope of this article to provide a comprehensive overview of the wide variety of design traditions and schools. However, we would like to present a selection of basic principles as they apply to internet dictionaries, before addressing more dictionary-specific issues.

It is not possible to answer, in general terms, the question of what design should actually accomplish. Some text or page design is intended to put the user in a particular mood and make them associate the content with a particular experience, usually an emotional one. This is the domain of UX design (user experience design), and, although this aim seems to be of greater importance for marketing and product pages, it also plays a role in internet dictionaries. For reference works, for example, an appearance which communicates 'reliability' and 'credibility' might be appropriate, comparable with news broadcasting. A dictionary that addresses a very specialist group of users - for example, sportspeople or computer enthusiasts - might prefer to adopt a 'modern' or 'fresh' look. However, conveying information quickly and simply should be a common goal of most dictionaries, so that design principles such as visual hierarchy, consistency and legibility play a significant role in most dictionary design decisions.

Here, legibility means the extent to which a text can be read easily and without tiring the eyes. Decisive in this context are design techniques such as line length, line spacing, font size, choice of font and the contrast between the colour of the font and the background.

Consistency (and repetition) refers to the uniform design of recurring elements, and, thereby, the reduction of cognitive effort on the part of the user, who does not have to learn the position and use of control elements of the interface again and again. The rule that 'less is more' also has a place here, since any newly created and different element must be repeatedly learnt, and understood afresh, by the user.

The principle of visual hierarchy means that every element on the page possesses a specific level of importance. If all the elements on a page have the same importance, then the user will not know where to look first. The visual hierarchy of the page should establish a structure to deliberately direct the user's attention towards particular focal points. The use of colour and scale are relevant design techniques in this context, as well as animations, which are particularly effective at securing and holding the user's attention.

Figure 24.2 demonstrates how design techniques such as white space and proximity, colour, contrast, scale, alignment, shapes and typography can be used in a dictionary text in different ways, and in combination with one another, in order to support the principles outlined above.
On websites, traditional design elements are supplemented by elements which originate in the field of native interface and input mask design and which facilitate the user’s interaction with the computer. In user interface design, components (also known as widgets) are the basic building blocks which are used to assemble more complex structures, such as the individual views of an application or the application as a whole. Components themselves are, in turn, made up of smaller components, or design primitives (lines, shapes, text) (see Figure 24.3).

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**Figure 24.2** Entry ‘administrator’ in *Dictionary of South African English*.}

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In addition, it is possible to distinguish these components according to their function. Hence, there are components:

- For grouping and organizing content, e.g. cards, lists, text sections, accordions
- For navigating within content, e.g. tabs, navigation drawer, navigation bars (top, side, bottom)
- For performing tasks or giving commands, e.g. buttons, menus
- For user input or selections, e.g. text input fields, select boxes, check boxes
- For messages or responses from the application, e.g. popups, progress bars, dialogue boxes, status bars.

A particular challenge for user interface design is that these components also have to be (repeatedly) recognized as such by the user. Hence, these components tend to exist in a similar form in all operating systems (Windows, Linux, Android, iOS). However, they intentionally diverge from one another in their specific design, in order to create an individual look and feel unique to the particular product. Websites, including internet dictionaries, make use of the same techniques and are able to design their own look and feel. If the design of the user interface diverges too far from the conventions of the operating system which is most familiar to the user, then there is a real danger that users will no longer recognize the components as interface components and will not know how to operate them.

Moreover, the implementation of the user interface design and interactive components is more demanding than that of static content. Components often possess several states, which have to be distinguished visually from one another. A button, for example, can be 'normal', 'pressed', 'focused', 'active' or 'disabled'. The implementation of design techniques must be
well organized, in order to ensure that these states can be distinguished from one another and that there is consistency in their presentation.

Users also require direct visual feedback to show whether their action has been successful or unsuccessful. For example, a button that does not change its state when the user clicks on it leaves the user unaware whether or not the computer has recognized the click and whether it will perform the required action. In this, modern user interface design (as of the year 2020) seeks to be as unobtrusive as possible. Instead of using text to provide lengthy status messages, an action button will change colour; for example, if the action has been successful, it will change to green and its label to a tick; if not, then it will turn red and the label will become a cross. Implementing these kinds of animated micro-interactions assumes at least basic knowledge about animations on the part of the designer.

Another complex area is accessibility, that is, design which ensures access without any barriers. The technical possibilities for accessible design have improved over the years on the part the browser, but (as of 2020) designers often still lack knowledge and experience in implementing these recommendations and guidelines. Standardization organizations, such as W3C, provide assistance in this area and are driving development forward, for example, with the Web Content Accessibility Guidelines (WCAG) 2.0. Nowadays, development tools in browsers indicate to designers whether, for instance, the contrast they have chosen between the foreground and background meets these guidelines. HTML itself includes additional mark-ups which make it easier for text-to-speech programs to read an HTML page. However, planning for all these technologies brings with it a discernible increase in design effort, and it is essential that these be taken into account in the design of internet dictionaries.

4.2 Specific aspects of internet dictionary design

4.2.1 Retrospective digital dictionaries

There are considerable overlaps with textual scholarship in the presentation of retrospective digital dictionaries, that is, print dictionaries, usually older ones, which are subsequently digitalized. One principal characteristic of these projects is often to achieve as exact a reproduction as possible of the original text. Hence, the pagination of the print version is frequently retained, to ensure that the online version can still be cited. Editorial interventions have to be marked and created in such a way that they are recognizable and so on.

In terms of design, a particularly interesting issue is how a relationship is constructed between the ‘modern’ dictionary application and the ‘old’ dictionary pages and content which are contained within it. This discontinuity is particularly striking in cases of image digitalization, where the user is presented with scanned images of the original dictionary. But that discontinuity can also be intentional, an indicator to the user to remind them that they are precisely reading a historical source, rather than a contemporary reference work.

By contrast, the opportunity presents itself in digital transcriptions of older print dictionaries to re-evaluate the original print design, for example, improving its clarity by introducing a clearer visual hierarchy or replacing an old-fashioned typeface, such as Fraktur, with a modern font in order to ensure legibility for twenty-first-century readers. If users are presented with a historical dictionary in the form of a contemporary design, then there is, of course, an increased risk that
the user will confuse it with a contemporary dictionary. Unfortunately, there are limited design options available to counteract this misunderstanding.

4.2.2 Content-centric presentation

On a very abstract level (and from a design perspective), many dictionary entries can be described as a structure in which the lexicographical information about a headword is organized into thematically related groups; then, alongside that information, these groups may contain further subordinate groups (e.g. primary meaning and secondary meaning). In content-centric design, the dictionary interface then reflects, in a more or less 1:1 manner, this tree-like structure, nested in as many levels as necessary.

This hierarchical structure is intended to enable the user to grasp quickly the structural organization of the entry, so that they can direct their attention to the relevant block. Of course, it is a prerequisite for this that the user has a prior expectation about what type of information they can find in which group and how this information can help them in answering their problem. Whether these expectations of users on the part of lexicographers are realistic is the object of enquiry in user research and dictionary design (cf. Section 3). Figure 24.3 shows the design techniques employed to translate this hierarchical lexicographical structure into a visual hierarchy.

4.2.3 User-/human-centric design

In user-centric design, it is no longer the lexicographical structure which stands at the centre, but rather design is oriented towards the actual task which the user is undertaking or the problem which they are seeking to solve. The dictionary Paronyme – Dynamisch im Kontrast, for example, is a dictionary which is intended to help the user with uncertainty about the meaning and usage of German paronyms. In many of the views in this dictionary, the design attempts to assist in the task of ‘comparing and contrasting’. Users see all of the partial meanings at a glance in a sortable overview and are able to choose up to three of them, receiving the corresponding detailed views, presented alongside one another in an overlay. This is intended to ensure that the user can access for themselves similarities and differences in the words, down to the level of individual examples of usage.

If the users’ tasks and questions are placed at the centre of the design, then the question arises as to why those tasks and questions should not be resolved at the point where they arise. The integration of dictionaries in text editing programs, for text production, for example, or in digital editions of texts, to ensure their comprehension, would be a logical next step. Here, dictionaries no longer appear as independent entities, but rather, as far as possible, fit seamlessly into the user’s working environment, in order to support them in their actual work, composing or interpreting texts. This is already standard today for very simple lexicographical questions, such as spelling or hyphenation. In these kinds of applications, the challenge for design lies more in the area of functional integration than in visual design.

4.2.4 Other features of online dictionaries

In addition to entries for individual words, internet dictionaries can provide a range of further texts, illustrations or applications which, above all, make it easier to access the information relating to the words contained in the dictionary. For one thing, there are overviews of word
entries which satisfy particular criteria: for example, in a dictionary of neologisms, a list of words which emerged in a particular time period; in a dictionary of loan words, lists of words borrowed from a particular language; or in a general dictionary, a list of all the words derived from proper nouns and so on. The word entries included in the lists are created as hyperlinks, so that these kinds of list not only have an information value referring to the content of the dictionary, but also provide possible points of access to that content.

Visualizations, such as word clouds, can also be used as navigation tools, inviting users to explore the content of the dictionary. This is all the more the case if these are interactive visualizations. For example, if a corresponding data model allows it, chains of loanwords from one language into a series of other languages can be represented as an interactive graph in which the user can navigate. Nevertheless, such complex representations are more appropriate for illustrative purposes and to encourage exploration of dictionary content; they are not suitable for quickly looking something up.

Finally, it is possible to integrate static illustrations, videos or audio data, alongside text and visualizations. Dictionary design has to plan for these kinds of elements: for example, decisions need to be taken as to whether photographs, film or audio clips should only be opened or started by clicking on them, whether they should be integrated into the dictionary interface or open in a new window or whether they should simply be signposted with hyperlinks, as appropriate. In conceptual terms, it is important, in each case, to ensure a close interconnection between the word entry and these kinds of feature.

5 The design of search functions

Users of internet dictionaries are familiar with three different search options, which they recognize from other websites: a simple search for a search term; a search for characteristics or attributes; and a full-text search (see also Pastor and Alcina, Chapter 8). Each of these possibilities not only offers advantages and disadvantages for the user but also poses challenges for the design of an internet dictionary.

The simplest form to search in an internet dictionary is to enter a search term into a search field (the position of which on the page should satisfy the familiar requirements for websites more generally). However, in both online and print dictionaries, there is the problem of how to search for a word the spelling of which you do not know. In internet dictionaries, this problem is addressed through fuzzy search options which tolerate errors. In cases where the lemma is not searched for, but rather an inflected form or a historical variant, (automatic) re-direction in internet dictionaries replaces the customary cross-references from print dictionaries. For this, the orthographic or morphological variants of a lemma are stored in a search index, where additional information can be provided, for example, information on their relationship with the lemma. Already when it is being typed into the search field, the search term can be automatically and incrementally completed, what is known as ‘type-ahead search’. Suggestions for words can also be shown (‘Did you mean ... ’), from which the user can select the relevant entry. If the entry for a single word is found, then this is usually shown directly on the screen. If a search generates multiple search results, then the situation is different, and these are displayed on a separate page of search results.
The value of a search for properties is, above all, to limit the massive number of hits for the user, something which is particularly common on websites for online retailers. Hence, shoppers in an online shop can search only for blue sweaters, made of cotton, with long sleeves and a V-neck, in a price range between $30 and $50. This is not easy to translate to dictionaries, since it does not usually help, when searching for a particular word, to limit that search according to word class, number of syllables, inflectability and so on. However, these kinds of searches by property do exist in internet dictionaries. They allow using the dictionary like a database: searching, for instance, in the context of lexicological research, for examples of verbs borrowed in the eighteenth century from French into Italian; searching for examples of word entries in which a quotation from Jane Austen provides the first attested usage in English; or searching for German neologisms from the 1990s which do not originate in English. In design, these kinds of search frequently draw on menus and dropdown lists, among other techniques. The results of the search are displayed on separate pages on which the results can often be further sorted or filtered, before the user finally, out of the whole mass of results, follows the hyperlinks to individual word entries or exports or prints the search results as a whole.

In a full-text search, a search term is generally searched for in the visible dictionary text, that is, in all word entries and, where applicable, also in the surrounding text, irrespective of whether the dictionary consists of textual data or structured data (cf. Section 2.2.2). To limit the number of hits, many internet dictionaries offer this search at specific levels of the text, for example, only in the definitions, the citations or the examples of usage. In terms of design, search results are displayed according to well-known models from other applications (e.g. Google), whereby a small snippet of the text is shown with the highlighted result. In cases with very high numbers of hits, the search results are distributed across several pages, so-called ‘paging’. A hyperlink leads from each snippet to the original dictionary text.

6 The design process

At the end of this presentation of the design of internet dictionaries, it is worth including some reflections on the process of design development. Where possible and appropriate, these should draw on well-known design frameworks and should, at least, give consideration to the use of templates. Finally, in the planning of a dictionary project, the design process should be integrated at an early stage into the lexicographical process, in order to facilitate the development of a form of presentation which is attractive, intuitive to use, and appropriate to the subject area of the dictionary and its intended function.

6.1 Established design frameworks

There is something to be said for engaging with the design guidelines and frameworks developed by the major producers of operating systems (Google/Android, Microsoft and Apple). As has already been mentioned in Section 4.1, it is the ‘native look and feel’ of the surrounding operating system to which users are most accustomed. They already have certain expectations about how
the elements on their screen should behave, and applications that do not hold to those conventions irritate, or even annoy, users. On top of that come the not inconsiderable effort and complexity involved in the development of a new design system. Adopting existing designs allows focusing on the development of the components specific to the application.

In addition to technical documentation and tutorials on web development, firms such as Google and Microsoft provide detailed documentation and, above all, explanations of their design guidelines, for example, Google's *Material Design*. The design systems, or guidelines, describe what has evolved over the years into ‘good practice’. They contain collections of standard components, colour schemes and also standard navigation and interaction models (for their platform). Pairs of ‘dos’ and ‘don’ts’ illustrations help designers to avoid making simple errors which can irritate users.

However, this consolidation of design conventions through market success does not always lead to the best possible design. A prominent example of this is our standard keyboard layout, which still follows that of typewriters and which is far from optimal in ergonomic terms. For this reason, user research (cf. Section 3) and creative experiments are important in order to question and challenge existing conventions.

Alongside the more gradual general development of design, there are also design fashions and trends. Perhaps best known is the Web 2.0 with its glossy image buttons (early 2000). Nowadays (as of 2020), so-called flat design tends to dominate. However, these are more stylistic elements than design elements in the strictest sense. Nonetheless, as is the case in fashion, what was once the latest style quickly appears old-fashioned in the present, if not outright ridiculous. Since internet dictionaries are mostly long-term undertakings, elements which are characteristic of a particular fashion should be used with caution. As they stand out, they can quickly make what is actually a well-designed and well-functioning site appear old-fashioned.

### 6.2 Templates

There are numerous resources on the internet which offer website templates, frequently as open-source material, free for anyone to use. These can be implementations by the manufacturer or by third parties of existing design frameworks, such as Google's *Material Design*, or implementations of their own designs. Many prominent websites make their own framework available, such as Twitter and its *Bootstrap* system. If a template is used in a great number of other projects, as *Bootstrap* has been, then the design acquires a certain prominence and familiarity. This degree of familiarity is an advantage in terms of usability. However, it becomes more difficult to distinguish one project from another visually.

A further definite advantage of using existing templates is the ability to draw on the work of professional designers and developers. However, because designers are oriented towards what is common in the market, these templates tend to be conceived more for blogs, portfolios and commercial or marketing sites. The particular requirements of internet dictionaries play no role at all. Depending on the framework, extending and modifying an existing template to one’s special needs can sometimes be expensive and can, in some circumstances, require just as much prior knowledge as implementing one’s own design.
6.3 Processes

The following lexicographical processes would be involved in producing an internet dictionary according to the waterfall model: starting with the planning and conception of the dictionary, the process would then move on to the preparation and provision of the dictionary sources for the creation of the word entries. Next, the web application would be implemented, followed by the proofreading and testing of the interface. Finally, the internet dictionary would be released or would go on sale. However, this linear process can be problematic in some circumstances: for example, problems that were not identified during the planning phase, or dealt with inadequately, can only be resolved later in a very time- and cost-intensive way. Moreover, feedback from users that is gathered only after release or delivery cannot be taken into consideration during the development of the dictionary.

When applied to the design of internet dictionaries, it is important to consider that the linear planning and realization of a dictionary project results in particular dependencies between content and presentation being identified only when it is too late and being reworked only at great cost, if at all. For example, an internet dictionary project plans to offer brief lexicographical commentaries in a small pop-up window. These commentaries cannot be generated as abbreviated versions of longer sections of text from the main entry or from abbreviations included in the entry. Instead, the data model has to provide for this information type from the very beginning.

For these reasons, an iterative design process should be chosen for internet dictionaries, in which developmental phases focusing on specific areas can be run on numerous occasions. In this kind of process, prototypes can be developed at an early stage or only specific elements of the subsequent application tested, so that feedback from users can also be taken into account in the planning stage. In this way, the conception of content and design should be interconnected from the outset, so that, at its best, the team involved in an internet dictionary project involves not only lexicographical expertise, but also expertise in IT and web design.

7 Conclusion

Whether in the print or electronic medium, dictionaries comprise not only content, but also the form in which this content is presented to users. In particular, for internet dictionaries, it is worth planning this presentation carefully, adopting in the process the best of both worlds, print lexicography and web design, in order to facilitate a successful user experience. To this end, specific technical and design expertise is required, in order to take a wide variety of decisions in the design process in consultation with the lexicographers responsible for the content. That this is being successfully accomplished more and more frequently demonstrates how far the design of internet dictionaries has developed over the last twenty-five years or so. Further development in this field is to be eagerly awaited.
References


