Assessing Real-World Applicability of Redesigned Developer Documentation for Certificate Validation Errors

ACSAC 2021 Artifacts description

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Research paper abstract

We face certificate validation errors commonly, yet the related tools and documentation had been shown to have very poor usability. Previous research suggests that just improving the error messages and corresponding documentation can have significantly positive effects. Our work aims at increasing the usability of certificate validation by 1) redesigning the API error messages and the corresponding documentation, and 2) validating the real-world applicability of the redesign by investigating the opinions of 180 IT professionals. We focus on the perceived obstacles, desired ideal form and overall satisfaction. The redesigned documentation exhibits a reliable significant decrease in perceived incompleteness, with a small amount of perceived bloat and tangle. The redesigned documentation, now published at a dedicated website, is preferred by 89% of our study participants.

1 Overview

The artifacts contain three major parts, discussed in more detail in separate sections:

1. The questionnaire used in the main study (described in Sections 3.1 and 3.2 of the paper and mostly present in Appendices A and B of the paper). Almost the same questionnaire was used for the auxiliary study described in Section 5.1 of the paper (the only adjustment being the random ordering of the two documentation conditions). More details on the questionnaire can be found in Section 2.
2. The anonymized dataset of all valid questionnaire answers and qualitative coding performed. Analyses of this dataset are the core of the paper and are present in subsection 3.4 and all parts of Sections 4 and 5. The dataset is primarily in the SAV format (636.8 kB), intended to be processed in *IBM SPSS Statistics*. Exports to other formats are available, see Section 3 for more details. The coding of participant reasoning for obstacles and preference is available as the ODS spreadsheet (*LibreOffice Calc*).
3. Lastly, the set of analyses files (scripts and outputs) producing all statistical results presented in the paper are included. The syntax files can be fully evaluated only in *SPSS* (although partially also in *GNU PSPP*). The output files are available both in the *SPSS*-specific format and PDF. For more details, see Section 4.

Lastly, Section 5 contains the listing of files included in this artifact set.

2 Questionnaire

As mentioned in the paper, the survey was running on our custom instance of *LimeSurvey* (limesurvey.org). At the moment of the study, we ran *LimeSurvey* version 3.22 (database version 359). Apart from being included in the paper appendix, we make the survey questionnaire also available in three additional formats:

- **PDF.** This visual export of the full questionnaire is easily comprehensible. It also displays the conditional

questionnaire logic: 1) At the beginning, we generate a random number from one to three determining the error case displayed and 2) the free-text issue reasoning questions are only displayed if the participant indicated the particular issue as present (*Yes* or *Rather yes*). The PDF version cannot be imported back into *LimeSurvey*.

- **HTML.** Similarly to the PDF version, HTML works well to get visually acquainted with the questionnaire content. As PDF, it cannot be imported back into *LimeSurvey*.
- **LSS.** A specific XML format of *LimeSurvey* that contains all the groups, questions, answers options and conditions. This file can be imported back to *LimeSurvey* when creating a new survey. Note that the survey uses a custom theme (a minimalist lab visual), but when imported, it will get assigned to the global default theme.

For simplicity, only the questionnaire of the main experiment is included. In *LimeSurvey*, we had separate instances for the pilot experiment and the auxiliary study, but these were identical to the main study with one exception: For the auxiliary study, the parts with documentation evaluation were set to be displayed in random order.

3 Dataset

The file `participants.sav` is the primary authoritative version of the dataset. The file is stored in an SAV format created by (proprietary) *IBM SPSS Statistics* (www.ibm.com/products/spss-statistics) of version 27. Apart from the original proprietary software, there are other options to access the data:

- **Alternative applications.** Apart from *SPSS*, the dataset can be opened in other programs such as *GNU PSPP* (www.gnu.org/software/pspp) or *JASP* (jasp-stats.org). Although fully capable to open the dataset, note that none of these applications is able to fully process the *SPSS* syntax files (see details in Section 4).
- **Additional formats.** For convenience, exports to other formats are also available: `participants.dta` (*Stata v14*, see stata.com) and `participants.csv`. Note that as CSV does not support data labels, an additional file `participants-labels.csv` is available, in which all data values are substituted by verbose textual labels.

The dataset contains participants from both the main and auxiliary studies (however, not from the pilot testing). Only valid participants are included (that is, participants cleaned out as described in the paper are not present).

All variables are labeled and almost all of them have labeled values (i.e. the variables are numerical underneath but the numbers have assigned textual descriptions for convenience). The variable names are prefixed according to their origin:

- **No prefix.** The only variable not prefixed is the unique participant ID.
- **Prefix g_.** General study variables (experiment, condition order, time spent with the questionnaire).
- **Prefix o_.** Variables from the part of the questionnaire evaluating the original documentation. Note that variables prefixed *o_obstacles_* are results of the qualitative coding of the free text answers in *o_issues_-[issue]_reasons*.
- **Prefix r_.** Variables from the part of the questionnaire evaluating the redesigned documentation. Note that variables prefixed *r_obstacles_* are results of the qualitative coding of the free text answers in *r_issues_-[issue]_reasons*.
- **Prefix p_.** Variables from the part of the questionnaire comparing the two documentation versions and expressing the participants' personal preferences. Note that variables prefixed *p_version_* are results of the qualitative coding of the free text answers in *p_version_-reasons*.
- **Prefix d_.** Variables describing the participant demographics and previous experience.

The results of the qualitative coding (described in Section 3.3 of the paper) are available in two files as ODS spreadsheets (*LibreOffice Calc*, see libreoffice.org). In each, selected variables from the dataset are copied and coded. For easier analysis, the coding results are saved in the main dataset as well.

The first file (`coding-obstacles.ods`) contains the participant reasoning for the documentation obstacles (dataset variables *o/r_issues_[issue]_reasons*). The second file (`coding-preference.ods`) contains participant reasoning for their overall preference (dataset variable

p_version_reasons). The first sheet of both spreadsheets contains the corresponding codebook. Each code has a name, short description, several (fictitious) prototypical examples illustrating its meaning, potential specification details and real sample quotes added at the end of the process to ease explanation in the paper.

Apart from the two coding files for participant reasoning, the file `coding-comments.ods` summarizes the comments from the final, free-text question (dataset variable *p_comments*). No specific coding was performed but several interesting comments were marked to be mentioned in the paper.

4 Analyses

Lastly, we publish all *SPSS* analyses presented in the paper. For better comprehension, the analyses are split into separate files corresponding to the paper subsection in which they are presented. Analyses for figures are collected in a file separate from those of paper subsections. For each subsection (and figures), three different files are present:

- **SPS syntax.** The SPS syntax file contains the commands to perform the analyses presented in the corresponding subsection of the paper, in the chronological order of appearance in the text. The commands can be run using *SPSS*. The commands rely on the variable naming used in the included dataset. The output produced by *SPSS* is also available (see below). The SPS syntax file can be also partially interpreted by *GNU PSPP*, but some analyses will not be available as *GNU PSPP* has much fewer features than *SPSS*.
- **SPV output.** The SPV output file contains the computed tables and statistics produced by running the SPS syntax file in *SPSS* on the included dataset. The outputs are not interactive and are no longer bound to the dataset. Note that the produced tables and statistics often contain more computations than presented in the paper as *SPSS* often runs multiple tests and precondition tests per command. Although SPV is a proprietary format of *SPSS*, it can be viewed using other applications as well – for example *GNU PSPP*.
- **PDF output.** The content of the PDF file is identical to the content of the SPV output file but is included for better compatibility.

Special note regarding the analyses for figures. The included analyses produce only absolute numbers depicted in the figures. This is due to multiple reasons: Firstly, the plotting capabilities of *SPSS* are not as expressive as I would require. Secondly, to achieve good comprehensibility of images, favourable data-ink ratio and consistent visual style, I redraw all paper figures manually in the vector editor. Thus, the graphs in the figures are only available as final PDFs.

5 File listing

This section lists all the files in this artifact set.

```
/
├── readme.pdf
├── analyses
│   ├── 3.4-participant-demographics.pdf
│   ├── 3.4-participant-demographics.sps
│   ├── 3.4-participant-demographics.spv
│   ├── 4.1-rq1-perceived-obstacles.pdf
│   ├── 4.1-rq1-perceived-obstacles.sps
│   ├── 4.1-rq1-perceived-obstacles.spv
│   ├── 4.2-rq2-ideal-form.pdf
│   ├── 4.2-rq2-ideal-form.sps
│   ├── 4.2-rq2-ideal-form.spv
│   ├── 4.3-rq3-overall-opinions.pdf
│   ├── 4.3-rq3-overall-opinions.sps
│   ├── 4.3-rq3-overall-opinions.spv
│   ├── 5.1-condition-order-effects.pdf
│   ├── 5.1-condition-order-effects.sps
│   ├── 5.1-condition-order-effects.spv
│   ├── 5.2-previous-experience-of-participants.pdf
│   ├── 5.2-previous-experience-of-participants.sps
│   ├── 5.2-previous-experience-of-participants.spv
│   ├── 5.3-documentation-redesign-stability.pdf
│   ├── 5.3-documentation-redesign-stability.sps
│   ├── 5.3-documentation-redesign-stability.spv
│   ├── figures.pdf
│   ├── figures.sps
│   ├── figures.spv
│   ├── figures-obstacles-codes.pdf
│   ├── figures-obstacles-severity.pdf
│   ├── figures-overall-opinions.pdf
│   ├── figures-part-severity.pdf
│   └── figures-preference-codes.pdf
├── dataset
│   ├── coding-comments.ods
│   ├── coding-obstacles.ods
│   ├── coding-preference.ods
│   ├── participants.csv
│   ├── participants.dta
│   ├── participants-labels.csv
│   └── participants.sav
└── questionnaire
    ├── questionnaire-all-variants.html
    ├── questionnaire-all-variants.lss
    └── questionnaire-all-variants.pdf
```