

# Evaluating the Good Practices of User Experience for Mobile and Electronic Governmental Services

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**Abstract:** With digitalization in the focus of governmental services for citizens, mobile services need to provide users with a good user experience and usability to encourage greater user acceptance. [SHB22] defined ten Good Practices to support greater User Experience and Usability for Mobile Governmental Services. These Good Practices are evaluated and validated in this paper by a User Study that consisted of Qualitative and Quantitative results. Good practices of user experience can help impact and support the integration of the basic user experience needs into the technical development processes for future digitalization of mobile governmental services.


**Keywords:** User Experience, Mobile Services, Mobile Governmental Services, Electronic Governmental Services, Usability, Digitalization

## 1 Introduction

Governments have realized the importance of digitalization in the last decades. However, most are still facing key challenges regarding adoption and user experience of these digitalized services. When developing or digitalizing services, electronic and governmental services have fallen short on requirements in security, privacy, but also largely user friendliness [CS19]. [KR19] have pointed out that technical requirements take priority over user experience requirements throughout this process. In order to create services that will be adopted and used, it is important to ensure that users see the value in them and that it is as familiar and as easy as possible. Building on previous research, this paper will present a user study evaluation of the Good Practices of User Experience and Design Research described in [SHB22]. The ten Good Practices presented in [SHB22] were based on desk research of user experience and design research that was done on various mobile government and electronic government services around the world. It is implied that when considering these good practices that the user experience and usability of the services will improve. This paper attempts to test this hypothesis on whether the Good Practices defined in [SHB22] are correlated to a positively perceived user experience and usability.

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The results of the user experience study presented consist of three electronic governmental (eGovernmental) and mobile governmental (mGovernmental) service pilots that were developed in the mGov4EU project, which is funded by the European Commission. By considering the data and feedback from this study, this will be considered in validating the significance of key user experience and design practices by investigating their impact on overall user satisfaction and comprehension. By analyzing the user feedback of the pilots, we test for a correlation between high scores on the Good Practices and improved user experience. The paper is structured in the following manner. The second and third section highlights related work and methodology. The fourth section presents the results of the user studies and the significance between the user experience, Good Practices and overall user satisfaction for the three pilots that were tested. The fifth section discusses the results and possible interpretations. The sixth and seventh sections summarize limitations and potentials for future work and conclusions.

## 2 Related work

This paper evaluates the Good Practices of User Experience and Design that were established in [SHB22]. They described ten Good Practices that were based on desk research in the field of user experience and design research of mobile government and electronic government research. The following Table 1 summarizes the Good Practices listed in [SHB22].

<b>Learnability</b>	The ability to easily use, remember, and learn a service.
<b>Minimalistic &amp; Simple Design</b>	Improves accessibility of user groups with varying capabilities.
<b>Language</b>	Simple Language that is understandable by a wide user group
<b>User Readable Terminology</b>	Terms used in buttons, labels, messages, should be simple, familiar, and understandable for users with little technical knowledge.
<b>Help and Feedback</b>	Resources for users to refer to when they have questions or need technical support.
<b>Error Handling</b>	Errors that disrupt the users experience should provide information on what happened and what the user can do next.
<b>Search and Filter</b>	Ability to search or filter through the server with key terms through the product.
<b>Operability</b>	Users can use the product or service with a high quality on any size or device type.

<b>Placement of Information</b>	Having a straightforward layout of information and clear instructions and functionality.
<b>Use of Colors</b>	The “look and feel” must be appealing to users to help impose trust, positivity, and consistency in the service.

Table 1 Good Practices listed in [SHB22]

These Good Practices are results of the desk research done by [SHB22]. [IW18] provided insights to learnability with their studies and research on how learnability can play a key role in improving user friendliness and eventually user acceptance. [KR19], [IW18], [CLH20], [SF20], [KMM18], [LUN16] supported [SHB22] second Good Practice on minimalistic and simple design, where their work contributed to understanding the challenge of providing a service to a user group with a wide range of needs. For “Help and Feedback” Good Practice, [SHB22] support it with examples from [SF20], [HB11] and their input on design patterns of how to communicate feedback to users in a user friendly way. [HB11] laid the foundation for the “Search and Filter” Good Practice with support of the findings in [SF20] for the convenience of the users in finding different functions. Research conducted by [IW18], [IW17] highlights operability and the use of mobile devices and user expectations. For “Placement of information”, this was summarized by research conducted by [KR19], [IW18], [CLH20], [SF20], [IW17]. It highlights the importance of placing the information in a straightforward and functional arrangement. Lastly, the “Use of Color” is supported by research by [IW18], [CLH20], [KMM18], where it is emphasized how color can negatively impact users perception or user experience.

### 3 Methodology

The study from which the data originates was conducted as a part of the mGov4EU project [mG24]. A mixed-methods approach was employed to assess the user experience of three separate pilots. Although the pilots share the general technology used, they differ in their respective use cases. User stories and tasks were created for each pilot. Tab. 2 offers an overview of the pilots’ use cases and the associated user stories.

<b>Pilot Name</b>	<b>Use Case Description</b>	<b>User Story</b>
I-Voting Pilot	Integrates mGov4EU identification mechanism and SDG-layer into the online voting system. Allows users to vote remotely and be authenticated.	User is a student voting on the usage of a donation for extracurricular activities. The user must prove their identity in the university voting portal, verify active enrollment by uploading a certificate, and cast a vote for the preferred use of a donation.

Smart Mobility Pilot	Applies mGov4EU infrastructure to state-subsidized mobility services. User uses the pilot to confirm eligibility for a discounted taxi ride.	The user, either a German citizen or an Austrian citizen in Germany, aims to receive a discounted taxi ride. Tasks involve selecting a region, proving identity, and, for Austrian citizens, obtaining proof of address. After completing these tasks, the user test concludes.
eSignature Pilot	Focuses on creating advanced and qualified electronic signatures meeting eIDAS-Regulations. Tests the eSignature building block in mGov4EU.	The user, a dual citizen (German/Austrian), has separate tasks: signing a code of conduct agreement for the Rugby Club using a German ID and uploading a business contract with signatures for the "GovAssist" project using an Austrian ID. The user needs to add partners and observers for the business contract and must complete these tasks to manage their commitments efficiently.

Tab. 2 Pilot use case and user story description [mG24]

The user study of the projects' pilots included key performance indicators (KPIs) (e.g., task success rate, time per task, ease of use), interview questions along their experience of different functions and tasks evaluated of the pilot and standardized questionnaires like the System Usability Scale (SUS) [Sy24] and the User Experience Questionnaire (UEQ) [LHS08]. The data originates from a set of three user tests that followed the same methodology. The pilots were tested with at least ten participants per pilot up to a maximum of 14 for one of them. Additionally, each pilot had a set of user tasks assigned to them. After task completion, participants were inquired about difficulties they encountered, their personal preferences and suggestions that might enhance user experience. After the user has completed their tasks, where they tested different functions or use cases from the pilot, they continued to the quantitative part of the user study. This included filling out the SUS, UEQ questionnaires and a set of post-test questions inquired about general feedback and impressions of the pilot.

In order to validate the Good Practices established in [SHB22], the following process was taken. Each participant's feedback from the user study was carefully examined and received a valence score for each Good Practice. The scoring system was based on the amount and severity of positive and negative feedback that fit a respective Good Practice. Scores were assigned on a five-point Likert scale ranging from "strongly negative (-2)" to "strongly positive (+2)". Therefore, if a user mentioned e.g., the mismatch of colors that were used or missing help structures, the score would be in the negatives, whereas if the feedback was positive, the respective Good Practice score would also be positive. However, when a Good Practice was not touched upon the score

would be zero indicating a neutral score. To validate the thesis the scores were checked for correlation with two established usability and user experiences questionnaires, namely the SUS and the UEQ. The primary objective of this validation was to investigate the relationship between adherence to Good Practices and perceived usability and user experience.

## 4 User Experience Study Comparison

This section presents the key findings and outcomes derived from the evaluation of the Good Practices and the results of the user study. The user study conducted within the mGov4EU project consisted of a sample of 34 participants, approximately evenly distributed between male and female participants. The participants were aged between 18 and 55 years, with almost 50 % having a master's degree and around 75 % describing themselves as tech-savvy.

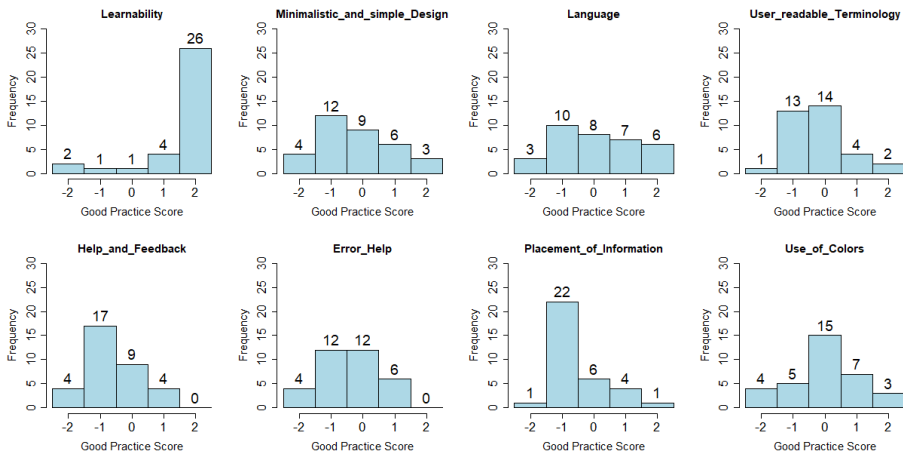


Fig. 1 Frequency of assigned scores per Good Practice (except Search and Filter, and Operability)

The qualitative data gathered from the evaluation was categorized and each participant's feedback received a rating per Good Practice following the scoring system. Fig. 1 summarizes the frequency of scores that were assigned to each Good Practice. The graphs indicate a prominent tendency towards higher scores only for the Good Practice of Learnability. At the same time, as no participant directly addressed the Good Practice of Search and Filter or Operability to an extent that would warrant assigning a weighted score, these two Good Practices were omitted from Fig. 1. However, the rest of the Good Practices were addressed extensively in the qualitative research, indicating a slight tendency towards lower scores.

### 4.1 Quantitative Insights on Good Practices

This case study focusses on the relationship between adherence to Good Practice and improved usability and UX. To validate this correlation, their relationship was analyzed. Fig. 2 presents the relationship between the participants' SUS score and their average Good Practice score resulting from the Good Practices rating system.



Fig. 2 Relationship between SUS Score and Good Practices Average

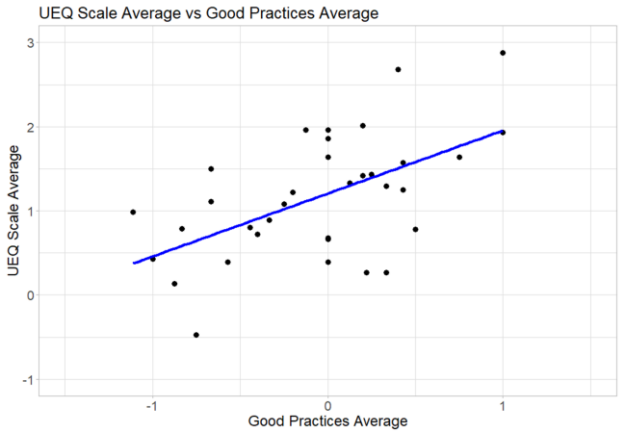


Fig. 3 Relationship between UEQ Scale Average and Good Practices Average

The correlation analysis revealed a statistically significant, strong, and positive linear relationship between the two variables ( $r = .77, p < .001$ ). Therefore, lower ratings in the Good Practices category seem to correlate with diminished perceived Usability as indicated by lower SUS scores. Similar to the relationship between the SUS score and Good Practices, the average of the six UEQ subscales also indicate a positive

relationship with the Good Practice score ( $r = .56, p < .001$ ) (see Fig. 3). These findings indicate a medium to strong correlation between adherence to Good Practices and improved usability and UX.

## 4.2 Qualitative Insights on the Good Practices

This section provides insights gathered from the qualitative feedback on which the categorization and Good Practice scores were based. Subsequently, the Good Practices will be addressed one by one to highlight their importance and further describe their impact on usability and UX.

The Learnability of a system poses an important aspect of the system's UX. It has a significant impact on how well users can grasp, execute, and recall actions within the system. In the usability evaluation, Learnability was mostly addressed by the users, when asked if they had problems executing a task and if they felt that they would be able to redo a task later on. A remarkable part of the study sample reported for almost all tasks, that they felt confident in repeating the tasks. Additionally, the straightforwardness of processes was mentioned multiple times in this context. However, users who were less confident in their comprehension of the task and the included steps often mentioned that certain breaks in their workflow threw them off. Therefore, to avoid user flow breaks that might impede Learnability, one should be aware of said breaks and either resolve them or if not applicable prepare the user for what is expected.

Adhering to the Good Practice of Minimalistic and Simple Design contributes towards the user's understanding and reduces cognitive load while interacting with a system. Users specifically addressed this Good Practice when commenting on the ease of recognizing the purpose of navigational UI elements or the clear association between icons and functionalities. However, when faced with a visually complex and unclear interface, users encountered challenges that hindered task completion. Therefore, when designing interfaces involving icons and other UI elements, one should not only keep cultural associations in mind but also carefully review the number of elements to prevent visual clutter. The Good Practice of Language relates to the use of widely understood languages for systems that cater to broad user groups. This involves abstaining from overly complicated texts or intricate wording. The goal is to offer a clear and simple way for users to understand the system, irrespective of their knowledge. It is important to note, that the adherence to this Good Practice varied tremendously between the three pilots. Nevertheless, even within a pilot group users reported different levels of understanding. This segmentation of users based on comprehension challenges highlights the critical role of clear language. At first User-Readable Terminology seems to head in a similar direction as the Good Practice of language but with some defining differences. Rather than assessing entire textual components, the focus lies on words that are typically stand-alone or with minimal context. This includes the labelling of buttons, tabs, functionalities, or simple elements like headlines. Users expressed a desire for alternative wording of certain use case specific terms, with abbreviations being

mentioned the most in this context. Difficulties arose in comprehending entire tasks and processes due to the terminology. This was especially prominent when users were faced with a decision that involved the use of a single digital gateway component (SDG-Component). The abbreviation itself was seen as the source of confusion; however, even after they were informed about its meaning, it did not contribute to their understanding. This highlights the need for terminology, that is universally understood by users irrespective of their demographics or technical proficiency. Aligning with this Good Practice, implementing features like tooltips or an info button for users to access explanations can contribute to user understanding while maintaining technical and legal integrity.

The second-lowest Good Practice score was reported for the category Help and Feedback. Help structures are responsible for assisting the user when they encounter challenges in achieving their goals. This need for assistance can be fulfilled by either means of direct interaction or software solutions that provide helpful insights. The primary goal should be to proactively prevent problems before they arise but in cases where challenges inevitably occur, users should be provided with suitable structures to resolve the situation. In the usability evaluation, the absence of feedback structures was pointed out on multiple occasions. Striking problems were found in the clarity of system status. At times it was unclear to the user whether they had completed tasks, whether the system was undergoing background processes, or in one of the worst scenarios, when users were not aware that an error had occurred. Features that were suggested by the users described the addition of progress bars into complex processes, as well as the option to obtain more information through user action (e.g., info buttons). Effective Error Handling is essential for preventing user frustration and maintaining trust and security within the application. Nevertheless, errors are often unavoidable. The way they are handled however strongly affects the users' chances to solve them. When designing error messages, it is important to include three aspects: First, the user should be made aware that an error occurred. Second, they should be informed about the nature of the error and provided with additional information that is relevant to them and the case. Third, they should receive clear and concise guidance on how to resolve the problem. Additionally, by reducing the time between the error cause and the error alert, the user can achieve a sense of agency that prominently highlights the importance of the error. The most frequent problems, that occurred in the usability evaluation can be summarized as user errors that stay undetected from the system, misunderstood, or overlooked error messages, and technical bugs without possible solutions for the user.

While the Good Practice of Search and Filter did not receive as much attention or detailed feedback as to warrant a specific valence score, users did express suggestions that fit this category. Generally, it is expected of a system that there is a way for users to search for specific information. This can be achieved by implementing either a search engine or employing filters. In one instance users reported the wish for a search function when they were asked to provide a contact email for one of the tasks. The search engine should replace the need to know the full address of known contacts. Whenever a



considerable amount of information is either presented or inquired search and filter options decrease the cognitive load a user has to deal with. Participants did encounter challenges related to the Good Practice of Operability, such as the scaling of the UI and unexpected swap of devices in one use case. However, the feedback they provided did not directly address operability. Nonetheless, developers should keep challenges related to adoption, interoperability, and various technical bugs in mind. Especially when the use case requires another device to be used, clearly informing the user about the specific processes becomes essential.

The average score for the Good Practice of Placement of Information turned out to be the lowest, indicating a higher prevalence of problems and criticism in this aspect. Strategic placement of information is critical to the user to comprehend the presented information and, consequently, to act in ways that work towards their goals. Employing recognizable formats, adding tooltips for unfamiliar words relevant to the user's actions, all while avoiding information overload, align with the principles of effective placement of information. Negative feedback additionally involved the prioritization of information in lists and not drawing the user's attention through changes in typography. Typically, the provided text was first read when the user could not continue without further information, or an error occurred. Therefore, information should be presented in proximity to the elements it is relevant for. This enables easy association and positively impacts the user's ability to navigate the application. The Use of Colors can influence user attention, contribute to visually appealing experiences, and support recognizability, but also negatively impact the user through inconsistent use or usage that contradicts their expectations. User comments expressed a desire for a more vibrant and engaging interface. Through highlighting and employing visual cues users are supported in understanding the significance of different elements. Furthermore, aligning the color scheme with the branding of the related provider contributes to a cohesive and branded experience, that can also spark familiarity with the service. To successfully use colors in UI design, one should keep user preferences, expectations, and general design principles in mind. The user feedback was fairly evenly distributed. Users who liked the use of colors either reported, that the use was generally a good fit for the application or that some visual cues were prominently designed due to the choice of color. However, users who disliked the use of colors reported some inconsistencies, a mismatch of colors with their expectations, or the general absence of colors in the UI.

## **5 Discussion**

This paper aimed to test and validate the Good Practices of mobile services that were described by [SHB22]. The Good Practices described by [SHB22], were based on desk research of user experience and design research in the field of mobile and electronic governmental services. This paper took the ten Good Practices and conducted a comparison of the Good Practices and the results of a user study of governmental services.

In order to validate the Good Practices, this paper depicts how the values of the quantitative and qualitative data were transformed into a scoring system on a five-point Likert scale of the impression of the Good Practices. The quantitative data considered KPIs, Task Questions, and a General Post Questionnaire. The qualitative data was based on interview answers and comments users gave throughout the user test as they completed different tasks of the various functions in the pilots. This was then checked for correlation with two already established usability and user experience questionnaires, the SUS and the UEQ. By transforming the qualitative and quantitative data into a Good Practice score and then comparing it to the results of the UX and Usability questionnaires this allows to validate and investigate the relationship between adherence to the Good Practices and the perceived user experience and usability. As the user study was constructed and conducted independently of the consideration of Good Practices, two Good Practices (e.g., Search and Filter & Operability) could not be included in this comparison as the results regarding these two Good Practices were not extensive enough to warrant assigning a valence scoring. The Good Practice Search and Filter was not thematized by any user feedback. This is likely due to the short and straightforward design of the user tests' tasks. The same goes for the Good Practice of operability. While there were comments that highlighted issues with operability, the volume of such comments did not reach a significant level.

The results showed that there is a statistically significant correlation found between the Good Practices and the scoring system that considered the user study data with user experience and usability. This implies that if the Good Practice has a positive value, then the user experience is also positive. In turn, this validated the outcome that the Good Practices indeed align with greater perceived user experience and usability. In addition to the correlation, as shown in Fig. 1 it can be observed that Learnability was the only practice that had a dominant positive impression. One could assume that to some extent, the learnability of the pilots was successful and easy to learn for the users. However, it is important to also consider that the users were asked more directly about aspects of how they understood and learned from their experience in the use case. This provided more opportunities to give feedback, whether it be good or bad. The following Good Practices showed a more distributed impression, Language and Use of Color. The remaining Good Practices showed a more negative leaning impression; Minimalistic and Simple Design, User Readable Terminology, Help and Feedback, Error Handling, and Placement of Information. The qualitative data from the mGov4EU user study showed a slight tendency towards negatively phrased feedback. Additionally, this bias toward negative feedback is supported by the inherent salience of hindrances over positive aspects of UX, if they were not inquired directly. Participants often find it easier to articulate hindrances or elements that impede the system's UX over reporting what elements had a positive impact. Therefore, although users were asked about positive and negative aspects of each task, it could be that users found it easier to articulate their challenges rather than what they liked. Overall, the results presented in this paper show that by applying these Good Practices it could improve or lead to a higher user experience for mobile service applications. This was supported by a statistically significant correlation supported by a

user study conducted on mobile governmental services.

## **6 Limitations and Future Work**

This study acknowledges the limitations of its methodology. As with every correlation, it is important to note that cause-and-effect relationships between identified usability issues and the absence of Good Practices are unclear. The central question of whether a subpar usability evaluation results from a lack of adherence to Good Practices remains open. However, the studies' results show a strong correlation between the two aspects and therefore warrant further investigation in this direction. Another potential limitation could be from the user study data, which consisted of three different pilots. The pilots generally used the same technology and had a great overlap on tasks that the users needed to conduct, regardless, each pilot had their own individual use case. The varying use cases could impact the overall familiarity and perception of user experience. In addition, participants often find it easier to articulate challenges or negative aspects in a user test, it is important to ensure that users are given the opportunity to balance this with direct questions of positive feedback. To gain a deeper understanding of the impact of Good Practices on usability and UX, future research could employ a survey-based approach. This could eliminate the need for extensive qualitative categorization and open the scope of the study to a larger sample size. Moreover, the scope could be extended to develop a predictive model for UX evaluations based on identified Good Practices. This would involve correlating survey responses with UEQ subscales to predict areas with the most room for improvement and offer tailored recommendations for action that correlate with better scores for the respective subscale. The results could serve as a foundation for evidence-based design choices and their impact on perceived usability and UX.

## **7 Conclusion**

Overall, this paper aimed to look into the Good Practices that were defined by [SHB22]. These Good Practices were based on desk research of user experience and usability research done of various studies on mobile and electronic governmental services. The goal of this paper was to evaluate the Good Practices and seek if it is possible to validate them according to User Study Data, which consisted of Quantitative Data (General Questionnaires and Feedback, UEQ, SUS) and Qualitative Data (Interview questions throughout the User Test). In order to do that, the authors established a scoring system of the user study data to compare the Good Practices with the perceived user experience and usability. This led to testing and concluding with statistical significance that there is a correlation between the two. Leading to the conclusion, that these Good Practices indeed support greater perceived Usability and User Experience. The Good Practices can help support the future development and improvement of user experience and usability of mobile services, whether it be in a mobile governmental context or otherwise.

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