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Article — Published Version

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Information Systems and e-Business Management

Suggested Citation: Breitmayer, Marius; Arnold, Lisa; Winter, Michael; Reichert, Manfred (2024) : Exploring user editing preferences in electronic forms: an empirical study, Information Systems and e-Business Management, ISSN 1617-9854, Springer Berlin Heidelberg, Berlin/Heidelberg, Vol. 22, Iss. 1, pp. 171-207,
<https://doi.org/10.1007/s10257-023-00662-y>

This Version is available at:

<https://hdl.handle.net/10419/317725>

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Exploring user editing preferences in electronic forms: an empirical study

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Received: 18 January 2023 / Revised: 8 September 2023 / Accepted: 23 November 2023 /
Published online: 11 January 2024
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Abstract

Electronic forms, such as order entry or tax declarations, frequently serve as the primary point of contact between users and information systems. Given their significance, it's crucial that these forms are intuitive and not burdensome for users to complete. One key aspect influencing the intuitiveness of forms is the sequence in which individual fields must be filled. This article reports on an empirical study involving 162 participants, which explored the intuitiveness of user forms across diverse scenarios. The study had two main objectives. Firstly, it sought to understand how users perceive different sequences of form fields in terms of intuitiveness. Secondly, it investigated the possibility of an intuitive sequence for form fields. The study found significant differences in intuitiveness among various ways of organizing form field sequences. Furthermore, it revealed a common understanding among users about the (sub-)sequence in which form fields should be arranged, notably that fields requiring file uploads should be located at the end of the form. The findings of this study provide valuable insights for developing more intuitive user forms in process-aware information systems, thereby enhancing the overall user-friendliness of such systems.

Keywords Intuitive form ordering · Empirical study · User perception

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1 Introduction

Electronic forms are used in various contact points between users and information systems (Bargas-Avila et al. 2010; Beaumont et al. 2002). In a university context, for example, such contact points include the registration for a university course, the upload of a student submission, the publication of exercises by a supervisor, or the rating of uploaded student submissions. In general, forms are present in information systems from a plethora of domains to perform tasks such as applying for a job, providing personal data, or donating money to an organization. While these are only examples, they illustrate the relevance of electronic forms in everyday life.

Furthermore, forms also play a vital role in the context of Business Process Management (BPM) (Weske 2012) and corresponding process-aware information systems (PAIS) (Reichert and Weber 2012). In this context, forms are used to specify how users may interact with the process during its execution. Data-centric approaches to BPM (e.g., case handling van der Aalst et al. 2005, artifact-centric Cohn and Hull 2009 and object-aware process management Künzle and Reichert 2011), specify the behavior of business objects (e.g., order, invoice or application) in terms of object lifecycle processes (Steinau et al. 2019). The latter describe the behavior of objects in terms of states into which these objects may transition as well as the object attribute values required to complete these states (Steinau et al. 2019a, b). When executing data-centric processes (e.g., with frameworks such as PHILharmonic Flows Steinau et al. 2019; Künzle and Reichert 2011), this fine-grained representation of object behavior enables the automated generation of forms from lifecycle processes (Andrews et al. 2021), significantly reducing both implementation and maintenance efforts.

Figure 1 depicts object *Application*, its corresponding lifecycle process as well as the forms automatically generated for states *Creation* and *Checked*. Note that the order of steps in a state is used to organize the generated form.

Despite the importance of forms and the amount of related research, the topic of intuitively organizing form fields for users interacting with information systems, raises interesting questions (i.e., how to guide and support users filling in a form when interacting with the information system).

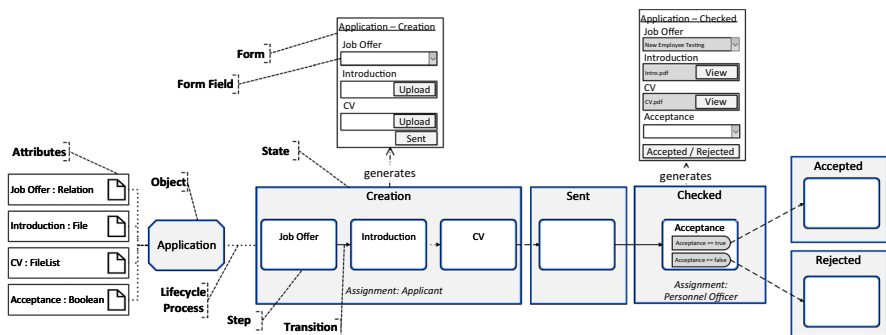


Fig. 1 Object Lifecycle Process with generated forms in PHILharmonic Flows

In this paper, we investigate how the sequence of form fields affects the intuitiveness of forms as well as the efficiency of users filling in the form. Intuitiveness refers to how intuitive the form is perceived, whereas efficiency evaluates the time required to complete the form. In particular, we are interested in how study participants perceive different variants of form field sequences with respect to intuitiveness and whether different sequences impact efficiency. Additionally, we are interested in whether a generally accepted and intuitive sequence of form fields exists. Furthermore, for the forms selected for the presented empirical study, we want to determine the most intuitive sequence of fields as perceived by the study participants. To achieve this, we present study participants with multiple variants of forms. In one variant, the form field sequence corresponds to the one observed in the real-world form. In the other, we randomly ordered the fields of the form, while keeping other factors (e.g., layout or field description), constant. Study participants then evaluate the form using multiple performance measures (e.g., suggested order, intuitiveness) and also provide their most intuitive sequence of form fields.

The results of the study shall allow us to generate more intuitive forms in general, and to improve the automatically generated forms in the context of object-aware process management (Künzle and Reichert 2011). Overall, this paper investigates the following four research questions:

RQ1: Does the sequence of fields influence the intuitiveness of a form?

RQ2: Does the sequence of fields influence the efficiency of a form?

RQ3: Are intuitiveness and efficiency in filling a form influenced by user experience?

RQ4: Does an intuitive sequence of form fields exist?

The remainder of this paper is structured as follows: In Sect. 2, we relate our work to existing research. Section 3 introduces theoretical backgrounds on generating forms in the context of Business Process Management (BPM). Section 4 provides information about materials and methods of the empirical study, including information on the study context, participants, materials, performance measures, and study design. Section 5 presents descriptive as well as inferential statistics. Section 6 discusses the obtained results. Finally, Sect. 7 summarizes the paper and gives an outlook on future work.

2 Related work

Due to the high relevance of forms for information systems of a variety of domains, the provision of intuitive forms is of utmost importance to ensure smooth information exchange between users and information systems. In literature, two main

branches of research can be identified in connection with forms: ① The design of usable forms and the ② mental load required from the users interacting with the forms. If a form is not intuitive, more interactions and time to complete it become necessary, decreasing both user satisfaction and effectiveness (Hassenzahl 2008; de Souza Lima and Benitti 2021).

To tackle these issues, a vast body of research was conducted. Regarding ①, central form aspects such as form content, form layout, input types, error handling, and form submission have been subject to research, and guidelines for (web) forms have been established by Bargas-Avila et al. (2010). However, not all guidelines are supported by empirical evidence, i.e., they are rather derived by experts using experience and best practices (Bargas-Avila et al. 2010; Seckler et al. 2014).

Regarding form content, the answers should be provided in a familiar format, and questions should be organized in an intuitive sequence according to Beaumont et al. (2002). Unambiguous answers should allow for answers in any format (Linderman and Fried 2004), and forms should be as short and simple as possible (Beaumont et al. 2002). If applicable, optional form fields should be marked using colors and asterisks (Pauwels et al. 2009).

Tullis and Pons (1997) investigate different techniques for visually distinguishing required from optional input fields in the context of forms. As one of the main conclusions there are indications that splitting required vs. optional form fields may be the best method. However, certain logical groupings of input fields exist, which recognizes the importance of form field sequences.

While the guidelines acknowledge the order in which form fields are displayed as relevant, a comprehensive understanding of intuitive form field sequences in the context of information systems is still lacking (see Guideline 1 of Bargas-Avila et al. 2010). Furthermore, with respect to the sequence in which form fields are displayed, the guidelines only suggest keeping an intuitive order of the questions that is analogous to the paper form layout (Bargas-Avila et al. 2010; Beaumont et al. 2002).

Considering the layout of forms, a variety of label placements become possible. Jarrett (2008) presents an eye-tracking experiment suggesting that the alignment of labels does influence the form layout. Consequently, Wroblewski (2008) suggests left-aligned labels for unfamiliar data, and top-aligned labels in case the form shall be completed quickly.

Input types (i.e., they type of form field) are also related to forms, and have, therefore, been subject to research. Linderman and Fried (2004) recommends using checkboxes, radio buttons, and drop-down menus to restrict the number of options as well as to indicate what kind of answer is expected. The study presented by Bargas-Avila et al. (2011) investigates the input types of checkboxes and lists boxes when selecting multiple answer options. The authors recommend the use of checkboxes instead of list boxes in this context. When considering form fields that require dates, only one input field should be used and format requirements (e.g., MM, YYYY) should be provided according to Christian et al. (2007). While different input types have an impact on the form, and potentially the sequence in which form fields are displayed, this aspect remains unconsidered in the works of Linderman and Fried (2004); Bargas-Avila et al. (2011); Christian et al. (2007).

When interacting with forms, errors might occur that need to be handled properly. In this context, Linderman and Fried (2004) conclude that error messages should clearly describe the mistake and the way it can be corrected. Moreover, a summary of error messages should be displayed when submitting the form according to Bargas-Avila et al. (2007). Another online study investigating the positioning of error messages on a form is presented by Seckler et al. (2012). Results of this study show that error messages that are displayed close to the erroneous input field result in significantly better performance and that error messages on the right side of the form field were rated as being most intuitive. Again, these studies do not consider the sequence in which form fields are presented.

After having submitted a form, Linderman and Fried (2004) advise to disable the submit button and to provide a confirmation to the user.

Some of the afore-mentioned guidelines have been empirically evaluated. Seckler et al. (2014) describe a controlled eye-tracking experiment in which existing forms are improved according to the guidelines and then compared to their initial specification. This study demonstrates the guidelines can help improve the usability of web forms. However, these studies do not consider the sequence in which form fields are presented.

Cruz-Benito et al. (2018) investigate how different versions of a form affect users after starting the form with respect to completion rate. The adapted version of the form aims at increasing the trust of users regarding form ownership as well as its intentions. In other words, the form was adapted according to the style guideline of other products of the owner, adding logos, a progress bar, automatic scrolling, deactivating buttons as well as grouping of similar questions. Completion rate decreases if users are redirected to a form version with higher complexity. Redirecting users to a simpler form, however, did not have an effect on form completion. In contrast to our work, Cruz-Benito et al. (2018) did not explicitly investigate the sequence of form fields.

Deniz and Durdu (2019) conducted a user study to compare the efficiency, effectiveness, and user satisfaction of mobile form controls. The authors state that radio button/switch and spinner/picker form controls provided the most efficient results and should therefore be used, which is in line with the findings of Tullis and Pons (1997). However, the order of form fields remains unconsidered.

In the context of older adults in e-government, Money et al. (2011) present form 23 guidelines focusing on assistance, trust, layout, technology as well as language. Regarding layout, Money et al. (2011) present 9 guidelines including font size, input fields, colors, images and text as well as relevance and logic. Considering the sequence of form fields, they suggest grouping related information to develop a sense of order. However, the actual sequence in which form fields should be displayed and the effect on intuitiveness remains unconsidered.

Garrett (2010) argue that a virtual environment should be as close as possible to the natural one. In case of forms, this is achieved by using a layout that is analogous to the corresponding paper form. Beaumont et al. (2002) recognize that the sequence of form fields is important and the need for an intuitive sequence is emphasized. However, the effects of different form field sequences as well as their effect on intuitiveness remains unconsidered in both works.

In summary, regarding ①, various aspects of forms (e.g., content, layout, input types, error handling, submission, trust, and mobile form controls) have already been researched, and (partly) empirically evaluated. However, to the best of our knowledge no works exists that empirically investigate the sequence in which form fields are presented.

Regarding ② (i.e., mental load), the study reported by Wästlund et al. (2008) analyzes the effects of page layouts (i.e., splitting a form over several pages) on mental workload and concludes that the experienced workload of users decreases when dividing web forms over several pages. This study, however, does not consider the sequence of the form field displayed.

In the context of an eye-tracking experiment, Lukanov et al. (2016) argue that dividing a form into subforms does not result in any differences regarding emotional or performance metrics, but significantly increases the workload. The conclusion is based on the application of functional Near Infrared Spectroscopy (fNIRS).

The eye-tracking experiment presented by Das et al. (2008) focuses on the alignments of labels in online forms and falsifies the results presented by Wroblewski (2008) as it recommends right-aligned labels. However, in this experiment multi-column forms were used, as opposed to single column forms, which are common in many information systems.

Al-Saleh et al. (2012) present an eye-tracking study dealing with the way web form entries are validated. Findings indicate that users tend to respond more frequently to error- or warning-related feedback than confirmation messages. Again, no implication on the sequence of form fields is provided in this study.

An online survey regarding format restrictions for form fields (e.g., correct formatting of a date or minimum length of a password) is presented by Bargas-Avila et al. (2011). In case a form field requires format restrictions, providing additional details on these restrictions to users leads to significantly fewer errors and trials. Again, the sequence in which the form fields are displayed is not considered.

In summary, regarding ②, the effects of splitting a form over various pages, label alignments, input validation, and field restrictions on mental load has already been researched using a variety of eye-tracking experiments. However, none of the presented works considers the sequence in which the form fields are presented.

3 Theoretical background

In object-aware process management, lifecycle processes are used to specify the behavior as well as the required data for objects at runtime. Object behavior (i.e., the data-driven changes of object states) is described in terms of a state-based object lifecycle process model (see Fig. 1 for the lifecycle process of object *Application*). Each lifecycle process state (e.g., states *Creation*, *Sent*, *Checked*, *Accepted* and *Rejected* in Fig. 1) comprises multiple steps (e.g., steps *Job Offer*, *Introduction*, and *CV* in state *Creation* of Fig. 1), which each correspond to the object attributes required to complete a respective state. In other words, steps refer to specific object attributes to be provided before

Fig. 2 Example Form generated in a Recruitment Scenario

The form consists of the following elements:

- Job Offer***: A dropdown menu with a red border and a downward arrow icon.
- Applicant**: A dropdown menu with a downward arrow icon.
- Address**: A large, empty rectangular text area.
- Introduction**: A text input field followed by a downward arrow icon and an upward arrow icon.
- Qualifications**: A text input field followed by a plus icon.
- Curriculum Vitae PDF**: A text input field followed by a downward arrow icon and an upward arrow icon.

completing the state. After all steps (i.e., required attributes) have assigned values, the object may transition to the next state (Steinau et al. 2019). Note that the data types of attributes are used to determine the input types of form fields, and existing control flow concepts (e.g., choices) are also supported by hiding or displaying the respective forms or form fields. Philharmonic Flows, an object-aware process management framework, supports a variety of different attribute types: Strings, Numbers, Boolean, Date, Files, Relations, and References (Künzle and Reichert 2011). Each of these attribute types may be configured to match the context of the modeled business process. Number attributes, for example, may be restricted to integers, certain ranges, specific values, extended to lists or a combination of them. Furthermore, the logic in which the steps of a state are organized provides the fundamentals for automatically generating corresponding user forms at runtime (Steinau et al. 2017). In Fig. 1, for example, the form generated based on state *Creation* has its form fields organized according to the logic of steps *Job Offer*, *Introduction*, and *CV*, and provides corresponding user navigation (i.e., cursor control).

Figure 2 depicts a real-world form automatically generated from a lifecycle process in a recruitment scenario. In order to apply for a job, applicants need to provide information on the *Job Offer* they apply for as well as the *Applicant (account)* in the recruitment system. Furthermore, applicants need to provide their *Address*, upload an *Introduction*, and provide tick their *Qualifications*. Finally, their *Curriculum Vitae* needs to be uploaded as a PDF file. After having filled all fields, the form may be completed.

Consequently, one of the main goals when modeling object-aware processes is to organize the steps of a states in a way that users are able to intuitively interact with the auto-generated form during process execution.

4 Materials and methods

4.1 Study context

Forms constitute the primary contact point between users and information systems (Beaumont et al. 2002). Thereby, providing users with intuitive forms constitutes a fundamental task to ensure that the exchange of necessary information happens smoothly. Existing literature has already contributed majorly to the design of forms (see Sect. 2). Although the sequence in which form fields are organized has been recognized as an essential factor in existing literature (Beaumont et al. 2002; Bargas-Avila et al. 2010), the different perception of users regarding the intuitiveness of a form has not been addressed empirically so far. Furthermore, whether an intuitive sequence of form fields exists has yet to be investigated. For this purpose, the paper presents insights we gained from a large empirical study in which forms from different scenarios and comprising various form field sequences are evaluated to understand the general effects regarding the intuitiveness of forms and respective field sequences. Besides, we analyze whether an intuitive sequence of form fields exists for the forms considered in this study.

The presentation of the results is organized as follows: To answer RQ 1 and RQ 2, the forms and corresponding performance measures are juxtaposed to identify different characteristics regarding their intuitiveness and efficiency (see Sects. 5.1 and 5.2). Regarding RQ3, we differentiate the results between experts and novices to identify effects on form experience. To address RQ4, we conducted a three-fold analysis. First, we gathered insights into different form field sequences are presented based on participant answers in free-text fields. In other words, we analyze the answers regarding positive and negative aspects of the presented form field sequence (see Sect. 5.3). Second, we analyze the intuitive form field sequences provided by study participants, deepening our understanding of how form fields should be organized (see Sect. 5.4). Third, leveraging the previously gained insights, the positioning of special form fields that require the upload of files is analyzed (see Sect. 5.5) in more detail. All findings contribute to the body of research towards the design of usable and intuitive forms to the users of (process-aware) information systems. Finally, the insights gained from our work may be applied to existing forms to facilitate user interactions and serve as indicators for forms to come.

4.2 Study design

In general, we relied on the methodologies from (Wieringa 2014) and (Yin 2017) to investigate the intuitiveness and efficiency of real-world forms, and to identify whether or not there is a common understanding on how form fields should be ordered.

The study design is depicted in Fig. 3. Each participant could only participate in the study once, and interruptions were considered as outliers. First, participants read the study description and gave their informed consent to the data collection. Next,

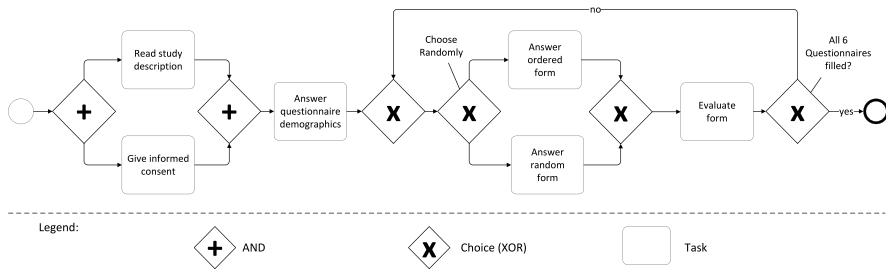


Fig. 3 Study design

participants had to fill in a questionnaire for the purpose of collecting relevant demographic data (e.g., age, gender, education, professional field, and the frequency they are in contact with (digital) forms in their everyday life, see Table 1), followed by the forms of Scenarios 1–6 in random order. For each scenario, participants received a short description, and, in case any personal data shall be collected, a note that no real personal data is required to comply with GDPR.¹ For each of the 6 forms the study participants are confronted with one of two form variants (see tasks *Answer ordered form* and *Answer random form* in Fig. 3). One variant corresponded to the form field sequence as observed in the template form the real-world scenario. In the other variant, we randomly ordered the fields of the form, while keeping other factors, such as the field description or layout, constant. Note that study participants might face the ordered form field sequence in one scenario, and the random one in another. Moreover, after completing a form, study participants had to evaluate each form according to the performance metrics described in Sect. 4.5. Prior to conducting the actual study, a pilot study with 13 participants was conducted to review whether the study design and the study material were appropriate.

4.3 Study participants

247 participants took part in the study during a ten-week period. 177 participants completed the online questionnaire resulting in a completion rate of 71.66%. 15 participants were identified as outliers and excluded from the analysis due to invalid responses or interruption of the study, leaving a total of 162 complete answers. The average completion time of the questionnaire was 23 minutes and 33 seconds, and the distinction between experts and novices results in 97 (59.88%) experts and 65 (40.12%) novices.

There were no prerequisites for participating in the online study, which was offered to students from our university as well as professionals in our academic network. However, the majority of participants were university students. Table 1 summarizes the sample description. Across all participants, 101 (62.35%) were male, and 61 (37.65%) were female, with an average age of 23,25 (std. 5.54) years. The

¹ General Data Protection Regulation: Europe's data privacy and security law.

Table 1 Demographic statistics

| | | All participants | Experts | Novices |
|--------------------|------------------------------|------------------|--------------|--------------|
| Age | Mean (SD) | 23.25 (5.54) | 23.21 (6.10) | 23.32 (4.58) |
| Gender | male | 101 (62.35%) | 57 (58.76%) | 44 (67.69%) |
| | female | 61 (37.65%) | 40 (41.24%) | 21 (32.31%) |
| Professional field | Management Science | 110 (67.90%) | 63 (64.95%) | 47 (72.31%) |
| | IT and Computer | 31 (19.14%) | 22 (22.68%) | 9 (13.85%) |
| | Not employed (anymore) | 5 (3.09%) | 2 (2.06%) | 3 (4.62%) |
| | Science | 4 (2.47%) | 3 (3.09%) | 1 (1.54%) |
| | Healthcare | 3 (1.85%) | 2 (2.06%) | 1 (1.54%) |
| | Service | 2 (1.23%) | 1 (1.03%) | 1 (1.54%) |
| | Production and Manufacturing | 2 (1.23%) | 1 (1.03%) | 1 (1.54%) |
| | Engineering and Technology | 2 (1.23%) | 1 (1.03%) | 1 (1.54%) |
| | Other | 3 (1.85%) | 2 (2.06%) | 1 (1.54%) |
| Education | Bachelor's degree | 68 (41.98%) | 39 (40.21%) | 29 (44.62%) |
| | High school diploma | 64 (39.51%) | 40 (41.24%) | 24 (36.92%) |
| | Studies without degree | 14 (8.64%) | 10 (10.31%) | 4 (6.15%) |
| | Master's degree | 10 (6.17%) | 4 (4.12%) | 6 (9.23%) |
| | Other | 6 (3.70%) | 4 (4.12%) | 2 (3.08%) |
| Total | N | 162 | 97 | 65 |

majority (41.98%) reported a bachelor's degree and are from the field of management science (67.90%) or information technology (19.14%).

To distinguish between experts and novices, participants were asked to evaluate how often they are in contact with (digital) forms in their everyday life using a 5-point Likert scale. This distinction results in 97 (59.88%) experts (i.e., frequent (39.51%) or very frequent (20.37%) contact) and 65 (40.12%) (i.e., occasional (31.48%), rare (8.02%) or no (0.62%) contact) novices. To be more precise, we dichotomize between experts and novices based on a self-assessment regarding the frequency they are in contact with forms. Prior assessment of the results with scatterplots (see Fig. 4) and on the theoretical justification for hypothesis testing (i.e., novices vs. experts), we concluded that a dichotomizing approach should not have undue effects on the results. Additional Plots are available.² Note that such an approach is related to several limitations (see Sect. 6.2) (Kuss 2013).

4.4 Study materials

In order to evaluate how the sequence of form fields impacts the users who interact with forms in the context of the study, we relied on six different forms from various scenarios. The forms were extracted from well-known interactions, such as the collection of personal data or a bank transfer. The forms selected for this study originated from different domains (e.g., recruitment Steinau et al. 2021, bank transfer

² <https://drive.google.com/drive/folders/1BSG4uFnavqrdzrBut7y0aLHrBwJVYhGf?usp=sharing>.

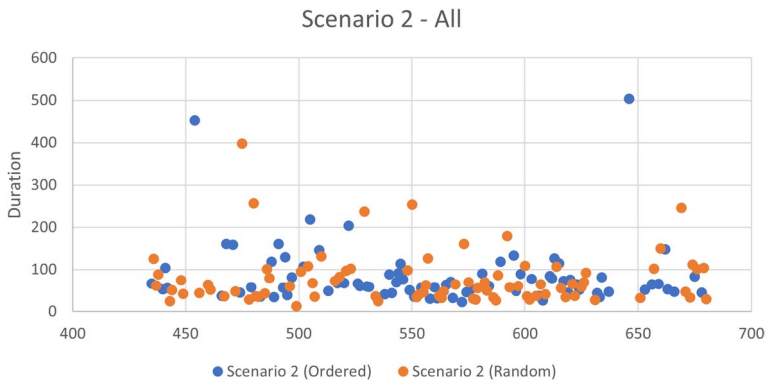


Fig. 4 Scatter Plot Scenario 2 All Users

Andrews et al. 2021, and e-learning Breitmayer et al. 2022). These forms varied in size and complexity (e.g., require uploads and checkboxes), which shall allow for a generalization of the results. We represent the forms using the questionnaire tool unipark³ during the study. Further, we ensured that the represented form was equal to the original with respect to form layout and input types (see Guidelines 5–12 in Bargas-Avila et al. 2010; Seckler et al. 2014). The forms were only presented in German language, i.e., the native language of the study participants. The German version of the questionnaire, screenshots of the forms represented in the study as well as translated version of the questionnaire are available.⁴

Note that the English version of the questionnaire was automatically translated from the German one, and may, therefore, contain smaller errors. Form fields that require users to upload files (e.g., a cover letter and cv in the context of an application) are represented as drag and drop elements within the form, simulating the uploading process. Regarding the form scenarios in this study, we selected six forms from different real-world scenarios. Table 2 summarizes the six scenarios regarding domain, number of form fields, and number of unique field types.

4.5 Performance measures

The following questions (i.e., performance measures) were considered for evaluating research questions RQ1 - RQ4:

1. Did you fill in the form in the suggested order? (Yes/No)

This question corresponds to the order in which participants filled in the form. Answers allow us to identify which forms were not filled in the suggested order

³ <https://www.unipark.com/>.

⁴ <https://drive.google.com/drive/folders/1BSG4uFnavqrdzrBut7y0aLHrBwJVYhGf?usp=sharing>.

Table 2 Study scenarios overview

| Scenario | Name | Domain | # Fields | # Unique field types |
|----------|------------------------|-------------|----------|----------------------|
| 1 | Publish exercise sheet | E-learning | 7 | 3 |
| 2 | Job application | Recruitment | 6 | 4 |
| 3 | Personal data | Multiple | 7 | 1 |
| 4 | Solution submission | University | 3 | 2 |
| 5 | Bank transfer | Banking | 5 | 2 |
| 6 | Submission rating | E-learning | 3 | 3 |

(i.e., top to bottom). We may derive the behavior of participants from this question.

2. How did you perceive the sequence in which the fields were displayed? (5-point Likert-scale: very unintuitive (1), unintuitive (2), neutral (3), intuitive (4) very intuitive (5))

Question 2 asks for the intuitiveness of the form and shall allow us to measure how intuitive participants rate the sequence in which the form fields were displayed. This shall enable conclusions on how participants perceived the displayed sequence of the form fields.

3. What was particularly good about the sequence presented? (free text, optional)

Question 3 allows participants to provide additional comments in case the sequence was particularly good. This, in turn, shall allow us to obtain insights into participant preferences.

4. What was particularly bad about the sequence presented? (free text, optional)

As opposed to Question 3, Question 4 allows participants to make additional comments in case the sequence was particularly bad. This shall allow us to get insights into participant preferences.

5. Bring the fields of the form into a sequence that is most intuitive to you (ordering via drag and drop)

We asked users to bring the form fields into a sequence which is most intuitive for them using drag and drop functionalities. This shall allow us to get an understanding of those sequences of form fields perceived as most intuitive by study participants.

6. Duration to complete each form.

To evaluate the efficiency of forms, we analyze the duration participants needed to fill in the form of each scenario. This shall allow us to potentially identify different efficiencies of users with varying sequences of form fields.

5 Results

5.1 Descriptive statistics

Tables 3, tab:DescriptivespsResultsspsExpert, 5 present mean (M) and standard deviations (SD) of the results obtained for the complete sample as well as for experts and novices respectively. Each table presents the considered performance measures 1 (suggested order), 2 (intuitiveness), and 6 (duration) (see Sect. 4.5), for all scenarios and both form variants.

5.1.1 All participants

Table 3 presents the descriptive results for all participants. Across most scenarios, the study participants reported higher deviations from the suggested order for the random scenarios. For all six scenarios, the ordered form field sequences reached a higher score in intuitiveness compared to the random condition. Regarding efficiency (i.e., time to complete the form), results are commingled with faster completion times for ordered sequences in scenario 3, and faster completion for random sequences in scenarios 1, 2, 4, 5, and 6.

5.1.2 Experts

In Table 4, the results of the forms filled by experts are presented. Across most scenarios, the experts reported higher deviations from the suggested order in random scenarios. For all six scenarios, the ordered form field sequences reached a higher score in intuitiveness compared to the random condition. Regarding efficiency (i.e., time to complete the form), results are commingled with faster completion times for ordered sequences in Scenarios 4 and 5, and faster completion for random sequences in Scenarios 1, 2, 3 and 6.

5.1.3 Novices

Table 5 contains the descriptive results of the forms filled by Novices. As opposed to the experts, novices reported higher deviations from the suggested order in Scenarios 4 and 5. For all six scenarios, the ordered form field sequences reached a higher score in intuitiveness compared to the random condition. Regarding efficiency (i.e., time to complete the form), results are commingled with faster completion times for ordered sequences in Scenarios 2, 4, and 6 and faster completion for random sequences in Scenarios 1, 3 and 5.

Table 3 Descriptive results all participants (N = 162)

| Descriptive Statistics for All Participants (Scenarios 1–3) | | | | | | | | | |
|---|---------------|--|----------------|--|---------------|--|---------------|--|--|
| Scenario | 1 | | 2 | | 3 | | | | |
| Ordered/random | o (N = 84) | | o (N = 79) | | o (N = 83) | | r (N = 79) | | |
| Mean/SD | M (SD) | | M (SD) | | M (SD) | | M (SD) | | |
| Suggested Order? | 1.08 (0.278) | | 1.06(0.245) | | 1.03(0.154) | | 1.06(0.245) | | |
| Intuitiveness | 3.64(0.977) | | 3.13(0.952) | | 4.13(0.997) | | 2.37(1.221) | | |
| Duration (s) | 123.73(83.69) | | 87.25(110.59) | | 64.05(42.01) | | 77.61(82.34) | | |
| Descriptive Statistics for All Participants (Scenarios 4–6) | | | | | | | | | |
| Scenario | 4 | | 5 | | 6 | | | | |
| Ordered/random | o (N = 80) | | o (N = 81) | | o (N = 73) | | r (N = 89) | | |
| Mean/SD | M (SD) | | M (SD) | | M (SD) | | M (SD) | | |
| Suggested order? | 1.04(0.191) | | 1.11(0.316) | | 1.08(0.277) | | 1.38(0.489) | | |
| Intuitiveness | 3.74(0.978) | | 3.48(0.896) | | 3.16(1.03) | | 2.43(1.086) | | |
| Duration (s) | 34.44(48.42) | | 159.72(109.72) | | 115.71(86.32) | | 112.56(78.69) | | |

Table 4 Descriptive results for sample experts (N = 97)

| Descriptive statistics for experts (Scenarios 1–3) | | | | | | |
|--|-------------------|------------------|-------------------|--------------------|-------------------|-------------------|
| Scenario | 1 | | 2 | | 3 | |
| Ordered/random | o (N = 52) | r (N = 45) | o (N = 53) | r (N = 44) | o (N = 53) | r (N = 44) |
| Mean/SD | M (SD) | M (SD) | M (SD) | M (SD) | M (SD) | M (SD) |
| Suggested Order? | 1.08 (2.69) | 1.09 (0.288) | 1.08 (0.267) | 1.11 (0.321) | 1.02 (0.137) | 1.09 (0.291) |
| Intuitiveness | 3.73 (0.992) | 2.89 (1.027) | 3.11 (0.913) | 3.00 (1.078) | 4.32 (0.936) | 2.50 (1.248) |
| Duration (s) | 129.27 (92.55) | 95.16 (54.88) | 90.21 (86.67) | 78.82 (63.73) | 86.08 (97.20) | 61.55 (42.14) |
| Descriptive statistics for experts (Scenarios 4–6) | | | | | | |
| Scenario | 4 | | 5 | | 6 | |
| Ordered/random | o (N = 48) | r (N = 49) | o (N = 52) | r (N = 45) | o (N = 47) | r (N = 50) |
| Mean/SD | M (SD) | M (SD) | M (SD) | M (SD) | M (SD) | M (SD) |
| Suggested order? | 1.02 (0.144) | 1.04 (0.2) | 1.12 (0.323) | 1.16 (0.367) | 1.11 (0.312) | 1.34 (0.479) |
| Intuitiveness | 3.67 (0.975) | 3.22 (0.985) | 3.50 (0.96) | 3.29 (1.014) | 3.47 (0.975) | 2.44 (1.072) |
| Duration (s) | 30.46 (28.78) | 44.24 (62.82) | 156.88 (63.61) | 164.09 (108.09) | 128.23 (91.79) | 125.54 (95.79) |

5.2 Inferential statistics

The insights presented in Sect. 5 are merely based on descriptive differences. A visual confirmation of the assumption has been conducted using histograms for each combination of scenario, user group (i.e., all users, experts, and novices) as well as form variant (i.e., ordered or random form field sequence). Fig. 5 depicts a histogram for Scenario 2 (i.e., the job application). Further visualizations are provided.⁵

In a nutshell, in some scenarios the visualization confirms a normal distribution, in others not. However, due to the large sample size in our study, violations of the normality assumption should not cause major problems (Ghasemi and Zahediasl 2012). Consequently, parametric procedures may be applied. To evaluate whether the differences described in the descriptive results reach statistical significance, independent-samples t-tests were conducted concerning the comparison of the performance measures in the context of RQ 1 and 2 (ordered vs. random; See Sect. 4.5). Prior significance testing, gathered data were checked for normality, including visual inspection of QQ plots and the employed of the Shapiro-Wilk test. The results indicated that some data deviated from normality. For a homogeneous presentation of the results, we relied on parametric test, since the large sample size ($n = 162$) contributed to the central limit theorem effect. All statistical tests were performed two-tailed, and the significance value was set to $p < 0.05$.

⁵ <https://drive.google.com/drive/folders/1BSG4uFnavqrdzrBut7y0aLHrBwJVYhGf?usp=sharing>.

Table 5 Descriptive results for sample novice (N = 65)

Descriptive Statistics for Novices (Scenarios 1–3)

| Scenario | 1 | | 2 | | 3 | |
|---------------------|-------------------|-------------------|------------------|---------------|------------------|---------------|
| Ordered/ Random | o (N = 32) | r (N = 33) | o (N = 26) | r (N = 39) | o (N = 30) | r (N = 35) |
| Mean/SD | M (SD) | M (SD) | M (SD) | M (SD) | M (SD) | M (SD) |
| Suggested order? | 1.09 (0.296) | 1.21 (0.415) | 1.04 (0.196) | 1.15 (0.366) | 1.03 (0.183) | 1.03 (0.169) |
| Intuitiveness | 3.50 (0.95) | 2.79 (1.111) | 3.15 (1.047) | 2.85 (1.089) | 3.80 (1.031) | 2.20 (1.183) |
| Duration (s) | 141.81 (96.62) | 119.03 (93.66) | 73.54 (44.12) | 75.72 (63.54) | 66.63 (37.78) | 64.23 (40.20) |

Descriptive Statistics for Novices (Scenarios 4–6)

| Scenario | 4 | | 5 | | 6 | |
|---------------------|---------------|---------------|--------------|-------------------|------------------|------------------|
| Ordered/ran- dom | o (N = 32) | r (N = 33) | o (N = 29) | r (N = 36) | o (N = 26) | r (N = 39) |
| Mean/SD | M (SD) | M (SD) | M (SD) | M (SD) | M (SD) | M (SD) |
| Suggested order? | 1.06 (0.246) | 1.03 (0.173) | 1.10 (0.31) | 1.08 (0.28) | 1.04 (0.196) | 1.44 (0.502) |
| Intuitiveness | 3.84 (0.987) | 3.21 (1.083) | 3.45 (0.783) | 3.00 (1.042) | 3.69 (0.928) | 2.41 (1.117) |
| Duration (s) | 20.88 (10.72) | 29.88 (28.70) | 149 (61.07) | 143.97 (83.70) | 90.69 (56.28) | 99.15 (55.26) |

**Fig. 5** Histogramm Scenario 2 all users

5.2.1 All participants

Table 6 reports the results of the independent-samples t-test regarding intuitiveness and efficiency of the analyzed scenarios, including the t-statistic, the degrees of freedom, and the two-tailed significance for the 6 scenarios considering the answers of all participants. Table 7 presents a summary of the significances identified for all users.

Intuitiveness (RQ1)

For Scenario 1, there was a significant difference in the intuitiveness scores for ordered form field ($M = 3.64$, $SD = 0.977$) and random form field ($M = 2.85$, $SD = 1.058$) conditions; $t(160) = 4.983$, $p < 0.001$. These results suggest

Table 6 Inferential statistics for RQ1 and RQ2 considering all participants (N = 162)

| Scenario | Intuitiveness (RQ1) | | | Efficiency (RQ2) | | |
|----------|---------------------|---------|-----------------|------------------|---------|-----------------|
| | t-statistic | df | Sig. (2-tailed) | t-statistic | df | Sig. (2-tailed) |
| 1 | 4.983 | 160 | < 0.001 | 0.528 | 160 | 0.598 |
| 2 | 1.241 | 160 | 0.216 | 0.174 | 160 | 0.862 |
| 3 | 10.049 | 150.680 | < 0.001 | -1214 | 114.742 | 0.227 |
| 4 | 3.301 | 160 | 0.001 | 0.585 | 160 | 0.559 |
| 5 | 2.116 | 160 | 0.036 | 0.108 | 160 | 0.914 |
| 6 | 6.890 | 160 | < 0.001 | 0.243 | 160 | 0.809 |

Table 7 Significance summary all users

| Scenario | Significance | |
|----------|---------------------|------------------|
| | Intuitiveness (RQ1) | Efficiency (RQ2) |
| 1 | ✓ | X |
| 2 | X | X |
| 3 | ✓ | X |
| 4 | ✓ | X |
| 5 | ✓ | X |
| 6 | X | X |

that the order of the form fields really does have an effect on the intuitiveness of forms. Specifically, these results suggest that the ordered form fields result in more intuitive forms.

In Scenario 2, there was no significant difference in the intuitiveness scores for ordered form field ($M = 3.13$, $SD = 0.952$) and random form field ($M = 2.93$, $SD = 1.080$) conditions; $t(160) = 1.241$, $p = 0.216$. These results suggest that the order of the form fields does not have an effect on the intuitiveness of forms.

For Scenario 3, there was a significant difference in the intuitiveness scores for ordered form field ($M = 4.13$, $SD = 0.997$) and random form field ($M = 2.37$, $SD = 1.221$) conditions; $t(150.680) = 10.049$, $p < 0.001$. These results suggest that the order of the form fields really does have an effect on the intuitiveness of forms. Specifically, these results suggest that the ordered form fields result in more intuitive forms.

For Scenario 4, there was a significant difference in the intuitiveness scores for ordered form field ($M = 3.74$, $SD = 0.978$) and random form field ($M = 3.22$, $SD = 1.019$) conditions; $t(160) = 3.301$, $p = 0.001$. These results suggest that the order of the form fields really does have an effect on the intuitiveness of forms. Specifically, these results suggest that the ordered form fields result in more intuitive forms.

In Scenario 5, there was a significant difference in the intuitiveness scores for ordered form field ($M = 3.48$, $SD = 0.896$) and random form field ($M = 3.16$, $SD = 1.03$) conditions; $t(160) = 2.116$, $p = 0.036$. These results suggest that the

order of the form fields does have an effect on the intuitiveness of forms. Specifically, these results suggest that the ordered form fields result in more intuitive forms.

For Scenario 6, there was a significant difference in the intuitiveness scores for ordered form field ($M = 3.55$, $SD = 0.958$) and random form field ($M = 2.43$, $SD = 1.086$) conditions; $t(160) = 6.890$, $p = < 0.001$. These results suggest that the order of the form fields really does have an effect on the intuitiveness of forms. Specifically, these results suggest that the ordered form fields result in more intuitive forms.

Efficiency (RQ2)

For Scenario 1, there was no significant difference in the efficiency scores for ordered form field ($M = 123.73$, $SD = 83.69$) and random form field ($M = 115.54$, $SD = 89.52$) conditions; $t(160) = 0.528$, $p = 0.598$. These results suggest that the order of the form fields does not have an effect on the efficiency. Specifically, these results suggest that both ordered and random form fields are filled in similar times.

For Scenario 2, there was no significant difference in the efficiency scores for ordered form field ($M = 87.25$, $SD = 110.59$) and random form field ($M = 84.65$, $SD = 77.47$) conditions; $t(160) = 0.174$, $p = 0.862$. These results suggest that the order of the form fields does not have an effect on the efficiency. Specifically, these results suggest that both ordered and random form fields are filled in similar times.

For Scenario 3, there was no significant difference in the efficiency scores for ordered form field ($M = 64.05$, $SD = 42.01$) and random form field ($M = 77.61$, $SD = 82.34$) conditions; $t(114.742) = -1.214$, $p = 0.227$. These results suggest that the order of the form fields does not have an effect on the efficiency. Specifically, these results suggest that both ordered and random form fields are filled in similar times.

For Scenario 4, there was no significant difference in the efficiency scores for ordered form field ($M = 34.44$, $SD = 48.42$) and random form field ($M = 30.66$, $SD = 32.35$) conditions; $t(160) = 0.585$, $p = 0.559$. These results suggest that the order of the form fields does not have an effect on the efficiency. Specifically, these results suggest that both ordered and random form fields are filled in similar times.

For Scenario 5, there was no significant difference in the efficiency scores for ordered form field ($M = 159.06$, $SD = 109.72$) and random form field ($M = 158.06$, $SD = 83.73$) conditions; $t(160) = 0.108$, $p = 0.914$. These results suggest that the order of the form fields does not have an effect on the efficiency. Specifically, these results suggest that both ordered and random form fields are filled in similar times.

For Scenario 6, there was no significant difference in the efficiency scores for ordered form field ($M = 115.71$, $SD = 86.32$) and random form field ($M = 112.56$, $SD = 78.69$) conditions; $t(160) = 0.243$, $p = 0.809$. These results suggest that the order of the form fields does not have an effect on the efficiency. Specifically, these results suggest that both ordered and random form fields are filled in similar times.

5.2.2 Experts

Table 8 reports the results of the independent-samples t-test regarding intuitiveness and efficiency of the analyzed scenarios, including the t-statistic, the degrees of freedom, and the two-tailed significance for the 6 scenarios for experts. Table 9 summarizes the significances identified for experts.

Intuitiveness (RQ1)

For Scenario 1, there was a significant difference in the intuitiveness scores for ordered form field ($M = 3.73$, $SD = 0.992$) and random form field ($M = 2.89$, $SD = 1.027$) conditions; $t(95)=4.099$, $p = < 0.001$. These results suggest that the order of the form fields really does have an effect on the intuitiveness of forms. Specifically, these results suggest that the ordered form fields result in more intuitive forms.

In Scenario 2, there was no significant difference in the intuitiveness scores for ordered form field ($M = 3.11$, $SD = 0.913$) and random form field ($M = 3.00$, $SD = 1.078$) conditions; $t(95)=0.560$, $p = 0.577$. These results suggest that the order of the form fields does not have an effect on the intuitiveness of forms.

For Scenario 3, there was a significant difference in the intuitiveness scores for ordered form field ($M = 4.32$, $SD = 0.936$) and random form field ($M = 2.50$, $SD = 1.248$) conditions; $t(78.384)=7.989$, $p < 0.001$. These results suggest that the order of the form fields really does have an effect on the intuitiveness of forms.

Table 8 Inferential statistics for RQ1 and RQ2 considering Experts (N=97)

| Scenario | Intuitiveness (RQ1) | | | Efficiency (RQ2) | | |
|----------|---------------------|--------|-----------------|------------------|--------|-----------------|
| | t-statistic | df | Sig. (2-tailed) | t-statistic | df | Sig. (2-tailed) |
| 1 | 4.099 | 95 | < 0.001 | 2.164 | 95 | 0.033 |
| 2 | 0.560 | 95 | 0.577 | 0.744 | 95 | 0.471 |
| 3 | 7.989 | 78.384 | < 0.001 | 1.659 | 73.642 | 0.101 |
| 4 | 2.222 | 95 | 0.029 | -1.385 | 95 | 0.169 |
| 5 | 1.052 | 95 | 0.295 | -0.395 | 69.394 | 0.694 |
| 6 | 4.932 | 95 | < 0.001 | 0.141 | 95 | 0.888 |

Table 9 Significance summary experts

| Scenario | Significance | |
|----------|---------------------|------------------|
| | Intuitiveness (RQ1) | Efficiency (RQ2) |
| 1 | ✓ | ✓ |
| 2 | X | X |
| 3 | ✓ | X |
| 4 | ✓ | X |
| 5 | X | X |
| 6 | ✓ | X |

Specifically, these results suggest that the ordered form fields result in more intuitive forms.

For Scenario 4, there was a significant difference in the intuitiveness scores for ordered form field ($M = 3.67$, $SD = 0.975$) and random form field ($M = 3.22$, $SD = 0.985$) conditions; $t(95)=2.222$, $p = 0.029$. These results suggest that the order of the form fields really does have an effect on the intuitiveness of forms. Specifically, these results suggest that the ordered form fields result in more intuitive forms.

In Scenario 5, there was a not significant difference in the intuitiveness scores for ordered form field ($M = 3.50$, $SD = 0.960$) and random form field ($M = 3.29$, $SD = 1.014$) conditions; $t(95)=1.052$, $p = 0.295$. These results suggest that the order of the form fields does not have an effect on the intuitiveness of forms.

For Scenario 6, there was a significant difference in the intuitiveness scores for ordered form field ($M = 3.47$, $SD = 0.975$) and random form field ($M = 2.44$, $SD = 1.072$) conditions; $t(95)=4.932$, $p = < 0.001$. These results suggest that the order of the form fields really does have an effect on the intuitiveness of forms. Specifically, these results suggest that the ordered form fields result in more intuitive forms.

Efficiency (RQ2)

For Scenario 1, there was a significant difference in the efficiency scores for ordered form field ($M = 129.27$, $SD = 92.56$) and random form field ($M = 95.16$, $SD = 54.86$) conditions; $t(95)=2.164$, $p = 0.033$. These results suggest that the order of the form fields does have an effect on the efficiency. Specifically, these results suggest that random form fields are filled in faster by experts.

For Scenario 2, there was no significant difference in the efficiency scores for ordered form field ($M = 90.21$, $SD = 86.67$) and random form field ($M = 78.82$, $SD = 63.73$) conditions; $t(95)=0.724$, $p = 0.471$. These results suggest that the order of the form fields does not have an effect on the efficiency. Specifically, these results suggest that both ordered and random form fields are filled in similar times.

For Scenario 3, there was no significant difference in the efficiency scores for ordered form field ($M = 86.08$, $SD = 97.20$) and random form field ($M = 61.55$, $SD = 42.14$) conditions; $t(73.642) = 1.659$, $p = 0.101$. These results suggest that the order of the form fields does not have an effect on the efficiency. Specifically, these results suggest that both ordered and random form fields are filled in similar times.

For Scenario 4, there was no significant difference in the efficiency scores for ordered form field ($M = 30.46$, $SD = 28.78$) and random form field ($M = 44.24$, $SD = 62.82$) conditions; $t(95) = -1.385$, $p = 0.169$. These results suggest that the order of the form fields does not have an effect on the efficiency. Specifically, these results suggest that both ordered and random form fields are filled in similar times.

For Scenario 5, there was no significant difference in the efficiency scores for ordered form field ($M = 156.88$, $SD = 63.614$) and random form field ($M = 164.09$, $SD = 107.09$) conditions; $t(95) = -0.409$, $p = 0.683$. These results suggest that the order of the form fields does not have an effect on the efficiency. Specifically, these results suggest that both ordered and random form fields are filled in similar times.

For Scenario 6, there was no significant difference in the efficiency scores for ordered form field ($M = 128.23$, $SD = 91.79$) and random form field ($M = 125.54$, $SD = 95.79$) conditions; $t(95)=0.141$, $p = 0.888$. These results suggest that the order

of the form fields does not have an effect on the efficiency. Specifically, these results suggest that both ordered and random form fields are filled in similar times.

5.2.3 Novices

Table 10 reports the results of the independent-samples t-test regarding intuitiveness and efficiency of the analyzed scenarios, including the t-statistic, the degrees of freedom, and the two-tailed significance for the 6 scenarios for novices. A summary of the identified significances is provided in Table 11.

Intuitiveness (RQ1)

For Scenario 1, there was a significant difference in the intuitiveness scores for ordered form field ($M = 3.50$, $SD = 0.950$) and random form field ($M = 2.79$, $SD = 1.111$) conditions; $t(63) = 2.773$, $p = 0.007$. These results suggest that the order of the form fields really does have an effect on the intuitiveness of forms. Specifically, these results suggest that the ordered form fields result in more intuitive forms.

In Scenario 2, there was no significant difference in the intuitiveness scores for ordered form field ($M = 3.15$, $SD = 1.047$) and random form field ($M = 2.85$, $SD = 1.089$) conditions; $t(63) = 1.133$, $p = 0.261$. These results suggest that the order of the form fields does not have an effect on the intuitiveness of forms.

For Scenario 3, there was a significant difference in the intuitiveness scores for ordered form field ($M = 3.80$, $SD = 1.031$) and random form field ($M = 2.20$, $SD = 1.183$) conditions; $t(63) = 5.765$, $p < 0.001$. These results suggest that the order of the form fields really does have an effect on the intuitiveness of forms. Specifically, these results suggest that the ordered form fields result in more intuitive forms.

For Scenario 4, there was a significant difference in the intuitiveness scores for ordered form field ($M = 3.84$, $SD = 0.987$) and random form field ($M = 3.21$, $SD = 1.083$) conditions; $t(63) = 2.455$, $p = 0.017$. These results suggest that the order of the form fields really does have an effect on the intuitiveness of forms. Specifically, these results suggest that the ordered form fields result in more intuitive forms.

Table 10 Inferential statistics for RQ1 and RQ2 considering Novices ($N=65$)

| Scenario | Intuitiveness (RQ1) | | | Efficiency (RQ2) | | |
|----------|---------------------|----|-----------------|------------------|----|-----------------|
| | t-statistic | df | Sig. (2-tailed) | t-statistic | df | Sig. (2-tailed) |
| 1 | 2.773 | 63 | 0.007 | 0.965 | 63 | 0.338 |
| 2 | 1.133 | 63 | 0.261 | -0.152 | 63 | 0.880 |
| 3 | 5.765 | 63 | < 0.001 | 0.250 | 63 | 0.803 |
| 4 | 2.455 | 63 | 0.017 | -1.666 | 63 | 0.101 |
| 5 | 1.920 | 63 | 0.059 | 0.270 | 63 | 0.788 |
| 6 | 4.839 | 63 | < 0.001 | -0.600 | 63 | 0.550 |

Table 11 Significance summary Novices

| Scenario | Significance | |
|----------|---------------------|------------------|
| | Intuitiveness (RQ1) | Efficiency (RQ2) |
| 1 | ✓ | X |
| 2 | X | X |
| 3 | ✓ | X |
| 4 | ✓ | X |
| 5 | X | X |
| 6 | ✓ | X |

In Scenario 5, there was no significant difference in the intuitiveness scores for ordered form field ($M = 3.45$, $SD = 0.783$) and random form field ($M = 3.00$, $SD = 1.042$) conditions; $t(63)=1.920$, $p = 0.059$. These results suggest that the order of the form fields does not have an effect on the intuitiveness of forms.

For Scenario 6, there was a significant difference in the intuitiveness scores for ordered form field ($M = 3.69$, $SD = 0.928$) and random form field ($M = 2.41$, $SD = 1.117$) conditions; $t(63)=4.839$, $p = < 0.001$. These results suggest that the order of the form fields really does have an effect on the intuitiveness of forms. Specifically, these results suggest that the ordered form fields result in more intuitive forms.

Efficiency (RQ2)

For Scenario 1, there was no significant difference in the efficiency scores for ordered form field ($M = 141.81$, $SD = 96.62$) and random form field ($M = 119.03$, $SD = 93.66$) conditions; $t(63)=0.965$, $p = 0.338$. These results suggest that the order of the form fields does not have an effect on the efficiency. Specifically, these results suggest that both ordered and random form fields are filled in similar times.

For Scenario 2, there was no significant difference in the efficiency scores for ordered form field ($M = 73.54$, $SD = 44.12$) and random form field ($M = 75.72$, $SD = 63.54$) conditions; $t(63)=-0.152$, $p = 0.880$. These results suggest that the order of the form fields does not have an effect on the efficiency. Specifically, these results suggest that both ordered and random form fields are filled in similar times.

For Scenario 3, there was no significant difference in the efficiency scores for ordered form field ($M = 66.63$, $SD = 36.78$) and random form field ($M = 64.23$, $SD = 40.20$) conditions; $t(63)=0.250$, $p = 0.803$. These results suggest that the order of the form fields does not have an effect on the efficiency. Specifically, these results suggest that both ordered and random form fields are filled in similar times.

For Scenario 4, there was no significant difference in the efficiency scores for ordered form field ($M = 20.88$, $SD = 10.72$) and random form field ($M = 29.88$, $SD = 28.70$) conditions; $t(63)=-1.666$, $p = 0.101$. These results suggest that the order of the form fields does not have an effect on the efficiency. Specifically, these results suggest that both ordered and random form fields are filled in similar times.

For Scenario 5, there was no significant difference in the efficiency scores for ordered form field ($M = 149.00$, $SD = 61.066$) and random form field ($M = 143.97$, $SD = 83.70$) conditions; $t(63)=0.270$, $p = 0.788$. These results suggest that the order of the form fields does not have an effect on the efficiency. Specifically, these results suggest that both ordered and random form fields are filled in similar times.

For Scenario 6, there was no significant difference in the efficiency scores for ordered form field ($M = 90.69$, $SD = 56.28$) and random form field ($M = 99.15$, $SD = 55.26$) conditions; $t(63)=-0.600$, $p = 0.550$. These results suggest that the order of the form fields does not have an effect on the efficiency. Specifically, these results suggest that both ordered and random form fields are filled in similar times.

5.3 Free text analysis

In addition to the descriptive and inferential statistical analysis conducted in Sects. 5.1 and 5.2, we analyzed the answers to the two free text performance measures (see Performance Measure 3 and 4 in Sect. 4.5). This allowed for insights into the comments provided by the study participants, as they could provide remarks on both positive and negative aspects of each form.

In total, ordered forms received 236 positive and 220 negative comments whereas random forms received 223 positive and 270 negative comments. A summary of positive and negative comments is presented in Table 12. In general, ordered forms received 16 more positive comments, whereas random forms received 47 more negative comments which is in line with the effects on intuitiveness identified in Sects. 5.1 and 5.2.

We further analyzed frequent answers provided by study participants. Therefore, we manually read all comments provided by study participants in performance measures 3 and 4 (see Sect. 4.5), across all scenarios, and consequently identified those comments that have been mentioned frequently. The threshold to be considered frequent was, that a certain aspect needed to be mentioned ≥ 5 times. This enabled us to identify those comments being mentioned frequently, while focusing on the most relevant comments provided.

Table 13 summarizes the most frequent comments (≥ 5) provided by study participants in performance measures 3 and 4 (see Sect. 4.5). Examples of the comments provided are, e.g., in Scenario 1 (ordered), that the general structure was perceived as positive, whereas the position of the upload field was disliked by study participants.

Furthermore, we identified frequent and uniformly negative comments especially for the random form variants. One possible reason for this could be the

Table 12 Positive and negative answers to free text performance measures

| | positive comments | negative comments | Difference |
|---------|-------------------|-------------------|--------------|
| ordered | 236 | 220 | +16 positive |
| random | 223 | 270 | +47 negative |

Table 13 Free text analysis—frequent (≥ 5) occurrences

| Scenario | Ordered (Occurrence) | | Random (Occurrence) | |
|----------|----------------------|-------------------------------------|---------------------|---|
| | Positive | Negative | Positive | Negative |
| 1 | Structure (7) | Upload (13) | – | Dates not together (13) |
| 2 | – | Uploads (17) | – | Uploads not together (9) Uploads not at last position (5) |
| 3 | Familiar (17) | – | – | Unfamiliar (10), Fields not together (13) |
| 4 | Upload (7) | Name not at first position (6) | – | Upload not at last position (7) |
| 5 | – | – | – | – |
| 6 | – | Position of Points and Feedback (5) | – | Bad Positioning (39) |

existence of a "mental model" that specifies in which order the form fields are expected by each study participant. In case the sequence in which form fields are presented deviates from the expected one, participants consider the form non-intuitive. Such mental models may result from prior experience with forms from similar scenarios (e.g., participants having provided personal data or submitted solutions in form) and are consequently important for the intuitive sequencing of form fields. This would be in line with both the findings from the descriptive as well as inferential statistics. All comments are publicly available.⁶

Across all scenarios and form variants, the position of upload fields has been commented most frequently (see Scenarios 1, 2, and 4 in Table 13), indicating that the position of certain form fields is especially important when providing intuitive forms.

5.4 Sequence analysis

In Performance Measure 5 (ordering via drag and drop, see Sect. 4.5), for each scenario, study participants had to bring the form fields of a scenario into a sequence that is most intuitive for them. The answers given to performance measure 5 (i.e., the intuitive form field sequences provided by study participants) allow for insights into RQ4 as well as a better understanding of which form field sequences are perceived most intuitive by the participants. We analyzed the intuitive form field sequences provided by study participants to identify form field patterns responded frequently. A pattern is identified in case the particular sequence of form fields is reported by more than 50% (i.e., 81) study participants. In this case, the baseline for the identification of a pattern is 50%. Note that if a general pattern (i.e., a pattern containing all form fields) is reported in $\geq 50\%$ of cases, there cannot be another pattern that is considered as more intuitive. For sub-patterns (i.e., the pattern does not contain all form fields), however, there may exist multiple sequences that are reported by $\geq 50\%$ of study participants. After having identified initial sub-patterns, we refine them

⁶ <https://drive.google.com/drive/folders/1BSG4uFnavqrdzrBut7y0aLHrBwJVYhGf?usp=sharing>.

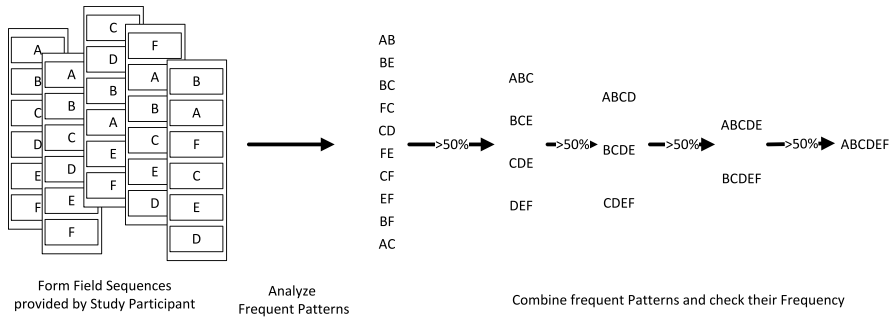


Fig. 6 Sequence Analysis

by searching for pattern combinations to identify more extensive patterns. Figure 6 depicts the sequence analysis procedure.

5.4.1 Scenario 1 (publish exercise sheet)

For this scenario, we could not identify a general pattern containing all form fields and being reported by more than 50% of study participants. However, we were able to identify (sub-)patterns of form fields that could be organized together, based on the sequences provided by study participants. The (sub-)patterns identified are: *Lecture Name* → *Name Exercise Sheet* (117 | 72.22%), *Name Exercise Sheet* → *Description* (106 | 65.43%), and *Start Date* → *End Date* (142 | 87.65%). Furthermore, we identified the (sub-)pattern of *Lecture Name* → *Name Exercise Sheet* → *Description* (92 | 56.79%). To be more precise, the majority of study participants reported these sequences as being most intuitive. Consequently, forms corresponding to Scenario 1 should include these intuitive sequences of form fields.

5.4.2 Scenario 2 (job application)

Similar to Scenario 2, we were not able to identify a general pattern representing a majority of study participants, but (sub-)patterns of form fields that should be organized together. The identified (sub-)patterns for Scenario 2 are: *Applicant Account* → *Address* (85 | 52.47%) and *Upload Cover Letter* → *Upload CV* (103 | 63.58%). In other words, 58.02% of the study participants reported the sequence of form fields *Applicant Account* followed by the *Applicant Address* as intuitive, and 63.58% of them reported sequence *Upload Cover Letter* followed by *Upload CV*. Thus, forms from this scenario should include these intuitive sequences of form fields.

5.4.3 Scenario 3 (personal data)

For Scenario 3, we identified a general pattern containing all form fields being intuitive for the majority of participants (54.32%). The pattern reported by 88 participants was as follows: *First Name* → *Last Name* → *Street Name* → *House Number*

→ *Zip Code* → *City* → *Country*. This indicates that there is a sequence of form fields being intuitive for the majority of participants. Thus, corresponding form fields should be organized accordingly. Including slight variations of the sequence (e.g., *Last Name* → *First Name* and *City* → *Zip Code*), this would correspond to 121 (74.69%) reported sequences. Hence, forms from this scenario should include these intuitive sequences of form fields.

5.4.4 Scenario 4 (solution submission)

In Scenario 4, we again identified a general pattern of form fields being intuitive for the majority of participants (73.46%). The pattern identified comprises form field sequence *Student Account* → *Exercise Sheet* → *Upload Submission*, which was reported by 119 (73.46%) participants. In other words, participants reported providing their student account, followed by the exercise sheet, and, finally, uploading their submission as most intuitive. This indicates that there is a sequence of form fields being intuitive for the majority of study participants, and corresponding form fields should be organized accordingly.

5.4.5 Scenario 5 (bank transfer)

For Scenario 5, we could not identify a general pattern being intuitive for more than 50% of study participants. However, we were again able to identify (sub-)patterns indicating that corresponding form fields should be organized accordingly, based on the sequences provided by study participants. The pattern consists of form fields *Amount* → *Purpose* (103 | 63.58%). Therefore, forms from this scenario should include this intuitive sequence of form fields.

5.4.6 Scenario 6 (submission rating)

For Scenario 6, we identified a general pattern that is intuitive for the majority of participants (62.35%). 101 (62.35%) study participants reported pattern *Submission* → *Rating* → *Feedback*. To be more precise, participants reported that inspecting the submission, then rating the submission, and, finally providing the feedback for the submissions as most intuitive to them. This indicates that there is a sequence of form fields being intuitive for the majority of participants and that corresponding form fields should be organized accordingly.

5.4.7 Summary sequence analysis

A summary of the 6 scenarios is provided by Table 14. In 3 out of the 6 scenarios, more than 50% of the study participants reported the same general pattern (i.e., a sequence of all form fields) being intuitive. In the remaining 3 scenarios, more than 50% of the study participants reported (sub-)patterns that do not correspond to a

Table 14 Sequence analysis summary

| Scenario | Description | General pattern | Sub pattern |
|----------|------------------------|-----------------|-------------|
| 1 | Publish exercise sheet | X | ✓ |
| 2 | Job application | X | ✓ |
| 3 | Personal data | ✓ | ✓ |
| 4 | Solution submission | ✓ | ✓ |
| 5 | Bank transfer | X | ✓ |
| 6 | Submission rating | ✓ | ✓ |

full sequence being intuitive. To be more precise, in 3 scenarios we identified a single pattern comprised of all required form fields that was reported being intuitive, whereas in the other 3 scenarios, we identified certain form fields (i.e., (sub-)patterns) that should be organized together (e.g., *Purpose* followed by *Amount* in Scenario 5) and being considered intuitive. For a (sub-)pattern to be considered intuitive, it must have been reported by at least 50% of the study participants. In other words, the frequency at which a pattern is reported positively correlates with the intuitiveness of a form if it contains this pattern. The underlying premise is that the more often a pattern is reported, the greater the likelihood that participants will perceive a form with this pattern as intuitive.

5.5 Further findings

The insights from the free text analysis (see Sect. 5.3) and the sequence analysis (see Sect. 5.4) indicate that the positions of specific form fields (e.g., form fields that require uploading files) are crucial for the intuitiveness of forms. Consequently, we analyzed the positions of fields that require uploading files within the form field sequences provided by the study participants (see Performance Measure 5 in Sect. 4.5). Scenarios 1, 2, and 4 contained such form fields. Note that the task in performance measure 5 was to bring the form fields into the most intuitive sequence using a drag and drop ordering. No other prerequisites were required. In Scenario 1, 99 study participants (61.11%) positioned the upload field as the last form field in their intuitive sequence. Scenario 2 required two upload form fields, and 101 study participants (62.35%) reported at least one upload field as the last form field in the sequence, whereas 80 study participants (49.38%) reported both uploads in the last two positions. In Scenario 4, 150 study participants (92.59%) placed the upload form field at the last position in their intuitive sequences. Scenario 6 does not contain a form field that requires uploading files but provides the submitted solution the is to be rated. In this scenario, 117 study participants (72.22%) positioned the information at the beginning of the form field sequence.

The positions of upload fields within the intuitive sequences provided by the 162 study participants indicate that they preferred to upload files at the end of the form (e.g., *Exercise Files*, *Cover Letter*, *CV* and *Solution Submission*). In contrast, information required for form completion (e.g., submissions and bank transfer

information) should be provided at the beginning of the form. Consequently, when implementing intuitive forms, positioning upload fields at the end of the form, and providing required information at the beginning is beneficial regarding intuitiveness.

5.6 Summary

This subsection summarizes the results presented in Sect. 5, and answers the four research questions presented in Sect. 1. Table 15 summarizes the main findings of our analysis. In many cases, existing work suggest ordering the fields in an intuitive sequence (e.g., analogous to the paper form layout Beaumont et al. 2002), however, to the best of our knowledge, the sequence in which form fields are displayed has not been empirically evaluated. Especially, the finding regarding RQ 4, i.e., that intuitive (sub-)sequences exist, provides interesting implications on how to design online forms and, consequently, delivers important insights for the design of forms in information systems. In a nutshell, an intuitive sequence of form fields exists, with the restriction that it may not contain all form fields. In other words, users expect all, or a subset of form fields in a certain sequence for the form to be considered intuitive. Furthermore, certain form fields (e.g., form fields that require uploading files) are crucial for the intuitiveness, as most users expect to fill in a form before uploading files. Consequently, upload fields should be positioned at the end of a form. Deriving generic rules for all forms, however, requires additional research.

6 Discussion

Existing literature on forms recognize the sequence of form fields as important (see Guideline 1 in Bargas-Avila et al. 2010). However, they only suggest ordering the fields in an intuitive sequence being analogous to the paper form layout (Bargas-Avila et al. 2010; Seckler et al. 2014; Beaumont et al. 2002). The guidelines, therefore, neglect the capabilities of modern information systems (e.g., object-aware process management Künzle and Reichert 2011; Steinau et al. 2019) with respect to process flexibility and the concomitant adaption of generated forms.

Regarding RQ 1, we evaluated whether the sequence in which form fields are displayed influences the intuitiveness of the form. Our study revealed that the sequence in which form fields are displayed to participants significantly influences the intuitiveness of forms in 5 of the 6 scenarios across all participants. Ordered forms (i.e., according to real-world forms) had significantly higher intuitiveness than randomly ordered forms (i.e., intuitiveness rating) for all participants. In Scenario 2 (i.e., Job Application) no significant effect was observed. This might be explained with the fact that the majority of study participants were students not being in touch with job application forms as often as they had been with the forms of the other scenarios. Another reason might be, that the ordered sequence of form fields, derived from a real-world application form, is not intuitive in this application already.

Regarding the efficiency of users interacting with forms, existing research investigated, amongst others, the influence of form layouts with mental workload (Lukanov

Table 15 Results summary

| RQ | Description | Summary |
|----|---|--|
| 1 | Does the sequence of fields influence the intuitiveness of a form? | The sequence in which form fields are displayed significantly influences the intuitiveness of forms. |
| 2 | Does the sequence of fields influence the efficiency of a form? | No significant difference in efficiency between ordered and random form field sequences has been identified. |
| 3 | Are intuitiveness and efficiency in filling a form influenced by user experience? | The sequence of form fields significantly influences the intuitiveness for both experts and novices. No significant difference has been identified regarding efficiency. |
| 4 | Does an intuitive sequence of form fields exist? | An intuitive sequence of form fields exists. However, such sequences may not include all form fields, but a subset of form fields. |

et al. 2016; Wästlund et al. 2008). Forms that conform with the guidelines require less interactions and less time. Additionally, the workload experienced by users decreases when dividing forms over several pages.

Regarding RQ 2, we investigated whether participants perform differently between ordered and random form field sequences. Across all six scenarios, there is no significant difference in efficiency between ordered and random sequences when investigating all study participants. Concerning mean duration, random form sequences were completed faster in Scenario 1 (i.e., Publish Exercise Sheet & difference = 8.19 sec), Scenario 2 (i.e., Job Application & difference = 2.6 sec), Scenario 4 (i.e., Solution Submission & difference = 3.78 sec), Scenario 5 (i.e., Bank Transfer & difference = 81.66 sec), and Scenario 6 (i.e., Submission Rating & difference = 3.15 sec). In Scenario 3 (i.e., Personal Data), the ordered form sequence was completed faster (difference = 13.56 sec). Our results might be explained with the fact that we considered the time required to complete a form instead of other performance measures such as, e.g., the number of user interactions, mental workload or eye-tracking data obtained from users when filling in the form.

RQ 3 investigates whether intuitiveness and efficiency are influenced by experience. Therefore, we assigned participants to either the expert or novice group based on the experience reported in demographic data. Moreover, we investigated both intuitiveness and efficiency for these groups individually. Our study revealed that the sequence of form fields significantly influences the intuitiveness of the forms for both experts and novices in Scenarios 1 (i.e., Publish Exercise Sheet), 3 (i.e., Personal Data), 4 (i.e., Solution Submission), and 6 (i.e., Submission Rating). In those 4 scenarios, the ordered sequence was evaluated being more intuitive than the random one.

Regarding efficiency, significant differences between the evaluated sequences can be observed for experts in Scenario 1 (i.e., Publish Exercise Sheet), where the random sequence was completed faster than the ordered one. For novices, however, there is no significant difference in efficiency for each scenario.

RQ 4 investigates the actual ordering of form fields rather than the effects on intuitiveness and efficiency. For Scenarios 3 (i.e., Personal Data), 4 (i.e., Solution Submission), and 6 (i.e., Submission Rating), we identified a sequence of all required form fields being intuitive for more than 50% of the study participants. For Scenarios 1 (i.e., Publish Exercise Sheet), 2 (i.e., Job Application) and 5 (i.e., Bank Transfer) we could not identify a complete (i.e., including all required) sequence of form fields that is intuitive for most participants. However, we identified sub-sequences of form fields that are being considered intuitive for more than 50% of the study participants. Consequently, a general understanding of intuitive form field sequences exists, and deviations from this sequence reduce intuitiveness.

The analysis of form field sequences provided by study participants allows for additional insights into the intuitiveness of form field sequences. In some scenarios (see Scenarios 3 (i.e., Personal Data), 4 (i.e., Solution Submission), and 6 (i.e., Submission Rating)), we have identified one sequence of form fields reported as intuitive by more than 50% of the study participants. In other scenarios we did not identify one generally accepted sequence of form fields, but sub-sequences that are reported as being intuitive by a majority of study participants (see Sect. 5.4).

Further, we analyzed the positions of specific form fields (e.g., form fields that require uploading files) and observed that study participants preferred to upload files at the end of a form, whereas information required for form completion should be provided at the beginning of the form.

In summary, the sequence in which form fields are displayed impacts the intuitiveness of forms, and a general understanding of intuitive form field sequences exists. Consequently, intentionally ordering form elements is beneficial regarding intuitiveness. However, there are no significant effects of form field variants regarding the time required to complete a form.

6.1 Implications

The provided insights have implications for practice as well as research. For practice, they demonstrate that the sequence in which form fields are displayed to the users have an impact on the intuitiveness of the form. For research, additional research on deriving the sequence of form fields in the context of implementing business processes is required.

6.1.1 Implications for practice

As forms are the predominant way of realizing interactions between users and information systems, these interactions should be as intuitive as possible for users. The results of the study provide valuable insights into the effects of form field sequences on the intuitiveness of forms. Furthermore, the identified sequences of form fields (see Sect. 5.4) allow recognizing essential aspects to be considered when organizing forms. It is a piece of valuable information that fields for uploading files are preferred to be displayed at the end of a form rather than in the middle or the beginning, or that information required to complete the form should be presented before uploading files. Such general insights enable a more intuitive form design in general and could lead to higher user satisfaction, while not impacting the duration to complete a form. Intuitiveness is also considered in the context of user experience (Hassenzahl 2008). Our results indicate that non-intuitive form field sequences drastically reduce the intuitiveness of the whole form, negatively affecting user experience. Consequently, providing user forms with intuitive form field sequences can drastically improve the user experience.

In the context of business process management (Dumas et al. 2018), forms are frequently used for implementing process models to collect required information at runtime. However, the optimal sequence of the form fields is often unknown and only a best-guess during the implementation of business processes. Our results, therefore, provide additional guidelines for implementing corresponding forms for business processes.

6.1.2 Implications for research

The results from the study confirm the results from other works regarding forms, i.e., guidelines (Bargas-Avila et al. 2010) or their empirical evaluation (Seckler et al. 2014). An interesting question for research based on the obtained results is: does the intuitiveness of form field sequences affect other performance metrics? Examples of such metrics include the correctness of form field values, the drop-out rate, or the mental load. Concerning mental load, it will be interesting to investigate the difference in cognitive load between intuitive and non-intuitive forms, enabling a more detailed investigation of form field sequences.

Additionally, identifying intuitive form field sequences in a generic fashion constitutes a challenge.

For data-centric approaches to business process management Steinau et al. (2019), and especially the ones capable of automatically generating forms Künzle and Reichert (2011), a challenge for research is to identify means to support modelers ensuring that the model used to generate forms correspond to intuitive sequences of form fields.

6.2 Limitations

Several factors limiting the study need to be discussed and addressed by the following studies.

First, the used forms and their form field sequences might need to be more representative. However, the forms used in this work are extracted from real-world scenarios and show various lengths, are of different complexity, and belong to various domains. The context in which forms are displayed may pose additional requirements on the sequence of corresponding form fields, for example, audit or legal restrictions. Consequently, the latter may impact the sequence of form fields resulting in non-intuitive forms.

Second, study participants constitute another limitation. We tried to have a balanced and heterogeneous sample, but the majority of participants were recruited from the field of management science as well as computer science. Participants from other fields or practitioners and different age groups may perceive other form field sequences as being more intuitive. The baseline variables related to age and professional field reflect differences between study participants, and the obtained results could also result from these differences.

Third, categorizing participants in the group of novices and experts based on a question about the frequency they are in contact with (digital) forms in their everyday life might be a naive approach and requires to be more precise. An additional expertise test might yield a more accurate categorization further strengthening the results. However, in our exploration, we were more interested in group than in individual differences. The reason is that we assumed that a dichotomization addressed more the fact how they think about their theories and the phenomena they study than any concerns about possible differences within groups.

Fourth, another limitation is the missing possibility of returning to the form while evaluating the performance measures. Therefore, the sequence in which the form

fields have been displayed must be kept in mind, and the risk of guessing the evaluation metrics due to incomplete or incorrect memorization increases.

Fifth, the performance measure of duration represents another limitation. The time to complete a form represents a performance metric. However, alternative performance metrics, such as providing the correct value in a form field, or the number of interactions required to complete the form may also be significantly impacted by the sequence of form fields.

Sixth, as the participants being entirely German, all study forms and notations are in German language. Based on different regions or languages, alternative form field sequences might be considered intuitive and should be investigated in the future.

Seventh, the study only considered strictly sequential form field sequences displayed on a single page. However, forms may also contain form fields organized side-by-side or distributed over several pages, which could also impact intuitiveness.

Eighth, the sequence analysis could potentially benefit from supplementary data to offer more definitive suggestions on the most intuitive order for form fields. Accordingly, we intend to delve deeper into this question in our upcoming studies. These future investigations will include larger, more diverse participant pools to ensure the applicability of our findings across different demographic groups. We also plan to explore a wider range of form types and scenarios, considering different industries and contexts. This could encompass everything from e-commerce check-outs and event registration forms to more complex processes like online tax submissions or medical history records.

7 Conclusion

This paper presented study results in which the sequence of form fields was evaluated across 6 different scenarios and 162 participants. Regarding RQ 1, participants perceived ordered forms as significantly intuitive juxtaposed to random form field sequences. These findings were valid for experts and novices (see RQ 3). There were no significant differences in the considered performance measures (i.e., time to complete a form) between ordered and random form field sequences (see RQ 2). For the 6 forms used in this study, we further investigated actual form field sequences provided by study participants to unravel sequences of form fields considered being intuitive for most study participants (>50%) in RQ 4. In 3 out of the 6 scenarios, we identified a single pattern containing all form fields that has been reported as intuitive by >50% of study participants. For the remaining 3 scenarios, we identified shorter intuitive form field patterns (i.e., they do not contain all form fields) reported by study participants. To be more precise, even if there is no pattern containing all form fields, we have identified patterns that are reported as being intuitive by a majority of study participants. Therefore, these form fields should be organized using the identified patterns. Consequently, we can positively answer the question whether an intuitive sequence of form fields exists (see RQ 4), with the restriction that the intuitive sequence might not always include all form fields but could also be a combination of some form fields that belong to each other. We further analyzed the position of particular form fields that require uploading files or documents. A

vast majority of the study participants preferred uploading files at the end of a form. This is especially important as it allows for a more general understanding of how form fields should be organized.

The results of our study emphasize the importance of the sequence in which form fields are organized in various scenarios. This is especially important in the context of data-centric approaches to BPM, where forms may be automatically generated from the conceptual specification of object behavior in terms of lifecycle process models. In a nutshell, the behavior of objects specified in lifecycle process models implicitly corresponds to the sequence in which form fields are displayed. As a result, the insights gained from this study may be used to (automatically) adapt existing lifecycle process models to increase the intuitiveness of resulting forms and serve as a guideline for modeling lifecycle processes concerning the forms generated in the future. Moreover, the results delve into intuitiveness concerning forms and allow for a more comprehensive understanding of how users prefer to interact with information systems using forms in general.

7.1 Future work

In our forthcoming research, we aim to enhance the scope of our study in two key ways.

Firstly, we will introduce a more refined expertise test to differentiate between expert and novice users. Currently, our criteria for categorizing participants as experts or novices is based on basic factors. However, to obtain a more precise classification, we intend to design a detailed, competency-based assessment that considers a range of skills and experience levels. This improved categorization could provide deeper insights into how user expertise influences form interaction, thereby enriching the robustness of our results.

Secondly, we plan to transform our study into a multi-case analysis by not only recruiting additional participants but also incorporating forms from diverse contexts. We'll gather data from a variety of scenarios, like online shopping checkouts, medical history records, educational surveys, and government documentation. This expansion of scope will enable us to identify trends and contrasts between different cases, contributing to a more comprehensive understanding of user preferences when interacting with forms.

Beyond these two major enhancements, we will also consider integrating a longitudinal study design, observing the same participants over a certain period. This can reveal how user preferences evolve over time and under different circumstances. Additionally, we also hope to examine the role of demographic variables, such as age, gender, and cultural background, to better understand their influence on form interaction patterns.

By extending our study in these ways, we aim to provide more nuanced and applicable insights for designing intuitive forms, thereby improving user engagement and satisfaction with information systems across various settings.

Author contributions All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by M.B. and M.W. The first draft of the manuscript was written by M.B. and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding Open Access funding enabled and organized by Projekt DEAL. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability The data that support the findings of this study are available from the corresponding author upon request.

Declarations

Competing interests The authors declare no competing interests.

Ethical approval Not applicable.

Consent to participate Informed consent was obtained from all individual participants included in the study.

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