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Applicability of User Experience and Usability Questionnaires

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Abstract: To be successful, interactive products need to fulfil user expectations and create a positive user experience (UX). An established method to measure UX involves questionnaires. What we aim in this paper is to present a list of user experience and usability questionnaires and its applicability for different digital products. A total of 13 questionnaires on usability and UX were analysed for this paper, and 25 factors were extracted from those questionnaires. A study was conducted based on this collection of factors with N=61 students. The study investigated the perceived importance of usability and UX factors for seven digital products. The goal was to have a collection of usability and UX factors that could be combined for suitable products evaluation. The results of the study revealed that no questionnaire covered all the factors perceived important by the participants.

Key Words: Content Validity, Questionnaire, Usability, User Experience, UX Factors
Category: H.5.0, H.5.2, H.1.2

1 Introduction

Today's users expect a high level of satisfaction while interacting with a product. Complex products, such as business applications, are no exception to this rule, even though their development traditionally focuses on functionality rather than user satisfaction. Users expect to be able to use the product without any major effort to solve their tasks in a quick and efficient manner. Furthermore, for a product to succeed, it is important to also consider hedonic interaction qualities, i.e. those that are not directly target-oriented [Preece et al. 2015].

[Kahneman 2010] points out that during interaction, users continuously assess a product as good or poor and thus implicitly form an unconscious evaluation. A conscious evaluation, however, is only made once they are asked to do so, i.e. always in retrospect. [Hassenzahl 2006] states that in doing so, users have to rely on their memory and remember the actual experience. More recent or very positive events are generally evaluated more strongly than others [Kahneman 2010]. Since user experience is defined as a subjective assessment by users, questionnaires are a simple, retrospective and cost-effective method to measure user experience. The study conducted in [Lazar et al. 2010] concludes that questionnaires with rating scales are used most frequently. In the past three decades, various standardized questionnaires to measure usability and/or user experience have become established. Those questionnaires measure both different and common UX factors. A single factor describes a user experience aspect and/or quality. The factor is made up of various items subsumed under that factor using suitable methods, such as the statistical method factor analysis. Summarized, a standardized questionnaire contains several UX factors. Each UX factors itself contains several items.

In this article, we will give an overview of the common questionnaires to measure user experience and the user experience factors contained in them, which have been identified by means of questionnaire analyses and consultation of experts. To this end, we will address the following research question:

RQ1: *What common factors do established questionnaires have?*

On this basis, we performed a study to determine the importance of those factors for various products. The result is intended to highlight the differences in perceived weighting of the factors regarding different products, and to point out to what extent the analyzed questionnaires reflect the factors perceived as important. This leads to the second research question:

RQ2: *Are there differences between the perceived importance of UX factors for different products?*

With this paper, we provide an understanding of the use of usability or user experience questionnaires. The result of the paper aims to show that not every questionnaire can be used meaningfully for any product.

This article is structured as follows. Section 2 presents the works related to different user experience models. Section 3 presents the implementation and results of a study related to the research question RQ1. In Section 4 we presents a study to validate RQ2. In Section 5 we discuss the results from the two studies. The article ends with Section 5 with conclusions and some ideas for future work.

2 Related Work

User experience has been defined as a holistic and multidimensional construct in ISO 9241-210:2010. The standard specifies that the user experience consists of a sum of different factors, such as emotions, experiences, attitudes, etc. However, the standard does not provide a definite list of factors or methods to measure user experience. The user experience, i.e., the user's experience when using a product, can be divided into four temporal phases [Roto 2011].

- Before usage (Anticipated UX): The user has certain prior experience and expectation when he wants to use the product.
- During usage (Momentary UX): During use, pragmatic qualities and usability are perceived.
- After usage (Episodic UX): After use, the user reflects on the interaction that has taken place. The evaluation retakes spot directly after use and at a time interval.
- Over time (Cumulative UX): The overall evaluation of the product by the user is the sum of the individual experiences that have taken place over a more extended period.

Since the beginning of the 90s, various models have been developed to illustrate usability and/or user experience. The literature review in [Ariza and Maya 2014] included all user experience models from the overview of the most cited user experience models in [Blythe et al. 2007], so we only present the summary of [Ariza and Maya 2014]. The result is summarized in Table 1.

Each model has a different focus to map user experience using factors. The models according to [Hassenzahl 2003, Forlizzi 2004, McCarthy and Wright 2007, Thüring and Mahlke 2007] follow the approach of holistic user experience mapping. Other models, in contrast, have different focuses. For instance, the models according to [Rhea 1992, Wimmer et al. 2011] focus on design, while [Desmet 2003] emphasizes emotions. Still, all models provide the advantage that the factors described and/or mapped allow for user experience to be measured [Law 2011]. Based on the model by [Hassenzahl 2003], for example, the AttrakDiff [Hassenzahl et al. 2003] questionnaire and the User Experience Questionnaire (UEQ) [Laugwitz et al. 2008] have been designed, and the meCUE [Minge and Riedel 2013] questionnaire has been developed for the CUE model.

Another alternative is to derive the factors not based on a model or definition, but instead in relation to a product and/or product group. This point of view allows factors to be derived which are important for the specific product or product group.

Author(s)	Year	Model
Rhea	1992	Design Experience Model
Alben	1996	Quality of Experience
Desmet	2003	Basic Model of Product Emotions
Hassenzahl	2003	Hedonic and Pragmatic Qualities
Forlizzi and Battarbee	2004	Interaction-Centered User Experience Framework
McCarthy and Wright	2004	Holistic User Experience Framework
Mahlke	2005	Integrative Model on Web User Experience
Roto	2006	User Experience Building Blocks
Jetter and Gerken	2007	A Simplified Model of User Experience
Thüring and Mahlke	2007	CUE-Model
Desmet and Hekkert	2007	Framework of Product Experience
Wimmer et al.	2011	User Experience of Interaction Aesthetics

Table 1: Models of user experience from [Ariza and Maya 2014]

[Schulze and Krömker 2010] have developed a framework to measure user experience for interactive online products. They argue that for user experience to be measurable, both the direct and indirect factors have to be known. The factors should consider human ways of viewing things and the system aspects. As a result of their study, they have identified the factors of Utility, Usability, Visual Attractiveness, and Hedonic Quality for interactive online products.

[Pirker and Bernhaupt 2011] followed a similar approach for interactive products in living rooms. They have determined factors using a self-developed questionnaire and subsequent interviews. The UX factors they have identified are Aesthetic, Utility, Purpose, Emotions, Stimulation, Identification, and Social Influences.

In a long-term study, [Sahar et al. 2014] addressed the question of which UX factors can be identified for multi-component sports products. Those factors were intended to map user experience before, while and after using the product. The UX factors determined were Effectiveness, Efficiency, Satisfaction, Utility, Stimulation, and Identification.

In summary, it can be concluded that both a UX model or a product evaluation can be used to identify the UX factors. Both methods, however, have the downside of not providing a conclusive list of UX factors, but rather a selection of factors that applies to a specific product or model. Even UX questionnaires extracted by the statistical method factor analysis or other types of correlation analysis do not provide a complete list of UX factors [Fabrigar et al.1999].

As noted in the introduction, UX questionnaires are a common quantitative measure of user experience [Lazar et al. 2010]. User experience questionnaires are characterized by the fact that they measure the subjective attitude of the user towards the test object. The respondent evaluates statements (items), for example by selecting a suitable category from the value range of a rating scale.

A number of UX questionnaires exist. Each questionnaire contains different scales for measuring groups of UX aspects. Questionnaires that measure pure usability aspects are, for example, the System Usability Scale (SUS) [Brooke 1986] and the Software Usability Measurement Inventory (SUMI) [Kirakowski and Corbett 1993]. Questionnaires covering the broader aspect of UX are, for example, the Visual Aesthetics of Websites Inventory (VisAWI) [Moshagen and Thielsch 2010], the User Experience Questionnaire (UEQ) [Laugwitz et al. 2008], and Standardized User Experience Percentile Rank Questionnaire (SUPR-Q) [Sauro 2015].

In the next section, we will analyze questionnaires to figure out different user experience factors.

3 Study 1 for RQ1: What common factors do established questionnaires have?

To answer the first research question, we have examined usability and UX questionnaires. The implementation and results are described in the next two sections. The research aimed to obtain a consolidated list of UX factors for the second study.

3.1 Implementation of Study 1

During the first step, we identified various questionnaires on usability and user experience from literature and internet search. The aim was to analyze those questionnaires that show relevance in the form of a scientific publication and were accessible during the research phase. In addition to general internet research [Perlman 2015], we also assessed other sources [Sauro and Lewis 2012, Hartson and Pyla 2012, Tullis and Albert 2008, Vermeeren et al. 2010]. The results can be found in section 3.2.1, table 2.

We analyzed the questionnaires identified in a first step. We extracted the factors using the corresponding associated scientific publication on the design of the questionnaire. In addition to analyzing the questionnaires, we identified further factors from a panel of experts. The participants of the panel of experts were both the authors and two other experts with extensive knowledge of user experience in the context of digital product development. The resulting list of the factors can be found in section 3.2.2.

In order to answer RQ1, *"What common factors do established questionnaires have?"*, the factors were consolidated in a final step. In this step, factors with the same meaning were combined. Consolidation requires a diligent approach since on the one hand, factors with the same designation may have different focuses due to the items of the factor, and on the other hand, factors with different designations may measure the same due to their items.

For instance, the two factors, *Minimal Action* and *Minimal Memory Load*, from the PUTQ questionnaire were assigned to the factor *Efficiency* since both factors increase efficiency. From the ISONORM questionnaire, the factor Error tolerance was assigned to the factor Controllability from ISONORM because it supports the user to control the product.

Despite diligent consolidation, exact comparability is only possible to a limited extent. The results can be found in section 3.2.3 and 3.2.4.

3.2 Results of Study 1

3.2.1 Identified Questionnaires

13 questionnaires (see Table 2) with a total of 25 different factors were identified.

The questionnaires can be divided into two categories. Questionnaires developed between 1986 and 1999 primarily measure usability criteria. Between 2003 and 2015, questionnaires were developed that also measure user experience aspects besides usability criteria. Only the questionnaires AttrakDiff2 (Model: Hedonic and Pragmatic Qualities), UEQ (Model: Hedonic and Pragmatic Qualities) and meCUE (Model: CUE-Model) based on a model. All other questionnaires are not based on a model.

3.2.2 List of UX Factors

The following list contains all the factors extracted from the questionnaires of Table 2. The consolidated factors (see section 3.2.3) have been added in parentheses and italics after the factor of the questionnaire.

Questionnaires that measure primarily usability criteria:

- **System Usability Scale (SUS):** SUS-Scale *(Overall)*
- **Questionnaire for User Interface Satisfaction (QUIS):** Overall Reactions to the Software *(Overall)*, Screen *(Simplicity)*, Terminology and System Information *(Controllability / Dependability)*, Learning *(Learnability / Perspicuity)*, System Capabilities *(Learnability / Perspicuity).*
- **Perceived Usefulness and Ease of Use (PUEU):** Usefulness *(Helpfulness)*, Ease of Use *(Ease of use)*
- **Software Usability Measurement Inventory (SUMI):** Global *(Overall)*, Learnability *(Learnability / Perspicuity)*, Helpfulness *(Helpfulness)*, Controllability *(Controllability / Dependability)*, Affect *(Emotion / Affect)*, Efficiency *(Efficiency)*

Author(s)	**Questionnaire**
Usability	
Brooke 1986	System Usability Scale (SUS)
Chin et al. 1988	Questionnaire for User Interface Satisfaction (QUIS)
Davis 1989	Perceived Usefulness and Ease of Use (PUEU)
Kirakowski and Corbett 1993	Software Usability Measurement Inventory (SUMI)
Prümper and Anft 1993	IsoNorm (IsoNorm)
Lewis 1995	Post Study System Usability Questionnaire (PSSUQ)
Lin et al. 1997	Purdue Usability Testing Questionnaire (PUTQ)
Gediga et al. 1999	IsoMetric Questionnaire (IsoMetrics)
User Experience	
Hassenzahl et al. 2003	AttrakDiff2 (AttrakDiff2)
Laugwitz et al. 2008	User Experience Questionnaire (UEQ)
Moshagen and Thielsch 2010	Visual Aesthetics of Websites Inventory (VisAWI)
Minge and Riedel 2013	Modular Evaluation of Key Components of User Experience (meCUE)
Sauro 2015	Standardized User Experience Percentile Rank Questionnaire (SUPR-Q)

Table 2: Overview of usability and user experience questionnaires

- **IsoNorm (IsoNorm):** Suitability for the task *(Helpfulness)*, Self-descriptiveness *(Learnability / Perspicuity)*, Controllability *(Controllability / Dependability)*, Conformity with user expectations *(Completeness)*, Error tolerance *(Controllability / Dependability)*, Suitability for individualization *(Flexibility)*, Suitability for learning *(Learnability / Perspicuity)*
- **Post Study System Usability Questionnaire (PSSUQ):** System Usefulness *(Helpfulness)*, Information Quality *(Controllability / Dependability)*, Interface Quality *(Learnability / Perspicuity)*
- **Purdue Usability Testing Questionnaire (PUTQ):** Compatibility *(Controllability / Dependability)*, Consistency *(Learnability / Perspicuity)*, Flexibility *(Flexibility)*, Learnability *(Learnability / Perspicuity)*, Minimal Action *(Efficiency)*, Minimal Memory Load *(Efficiency)*, Perceptual Limitation *(Learnability / Perspicuity)*, User Guidance *(Learnability / Perspicuity)*

- **IsoMetric Questionnaire (IsoMetrics):** Suitability for the task *(Helpfulness)*, Self-descriptiveness *(Learnability / Perspicuity)*, Controllability *(Controllability / Dependability)*, Conformity with user expectations *(Completeness)*, Error tolerance *(Controllability / Dependability)*, Suitability for individualization *(Flexibility)*, Suitability for learning *(Learnability / Perspicuity)*

Questionnaires that also measure user experience aspects besides usability criteria:

- **AttrakDiff2 (AttrakDiff2):** Attractiveness *(Appearance/ Attractiveness)*, Pragmatic Quality *(pragmatic Quality)*, Identity *(Identity)*, Stimulation *(Stimulation)*
- **User Experience Questionnaire (UEQ):** Attractiveness *(Appearance/ Attractiveness)*, Perspicuity *(Learnability/Perspicuity)*, Efficiency *(Efficiency)*, Dependability *(Controllability/Dependability)*, Stimulation *(Stimulation)*, Novelty *(Novelty)*
- **Visual Aesthetics of Websites Inventory (VisAWI):** Simplicity *(Simplicity)*, Diversity *(Originality)*, Colorfulness *(Appearance/Attractiveness)*, Craftmanship *(Craftmanship)*
- **Modular Evaluation of Key Components of User Experience (meCUE):** Effectiveness *(Helpfulness)*, Efficiency *(Efficiency)*, Visual aesthetics *(Appearance/Attractiveness)*, Status *(Identity)*, Commitment *(Loyalty)*, Positive/Negative emotions *(Emotion/Affect)*, Product loyalty *(Loyalty)*, Intention to use *(Immersion)*, Overall Judgment *(Overall)*
- **Standardized User Experience Percentile Rank Questionnaire (SUPR-Q):** Usability *(pragmatic Quality)*, Credibility *(Trust/Credibility)*, Loyalty *(Loyalty)*, Appearance *(Appearance/Attractiveness)*

3.2.3 List of Consolidated Factors

The complete list of consolidated factors used to answer RQ1 is provided in the following. For a better understanding of the meaning of the factors, a short description has been made to illustrate a user's expectation.

The list of the user experience factors was determined on the basis of the questionnaires examined.

- **Appearance/Attractiveness:** The product is attractive, beautiful and/or designed in an appealing way.
- **Completeness:** The user considers the information and/or functionality provided and/or offered to the user by the product to be complete.

- **Controllability/Dependability:** The product always responds to user interaction in a predictable and consistent way.
- **Convenience:** The product makes life easier and/or makes performing a task easier.
- **Craftsmanship:** The product appears to be of high quality and robust.
- **Ease of use:** The product is easy to operate.
- **Efficiency:** The user can reach their goals with minimum time required and minimum physical effort.
- **Emotion/Affect:** The product causes positive or negative emotions in the user.
- **Flexibility:** The user can adapt the product to their personal needs and requirements and/or their working style.
- **Fun:** Interacting with the product brings the user fun.
- **Helpfulness:** The product helps the user.
- **Identity:** The user can relate to the product and adopt properties of the product for himself.
- **Immersion:** When interacting with the product, the user loses track of time.
- **Intuitive Operation:** The user is able to operate the product with their present skills immediately and without any training or instruction by others.
- **Learnability/Perspicuity:** It is easy for the user to perform their tasks with the product.
- **Loyalty:** The user is so convinced of the product that they tell others about it in a positive way and use the product again and again themselves.
- **Novelty:** The product is new or innovative.
- **Originality:** The product is designed in an interesting and unusual way.
- **Overall:** Describes the overall impression of the product in general. The product is good or poor in summary. This is typically a valence factor.
- **Relevancy:** The information provided to the user by the product is relevant and/or significant to the user.
- **Pragmatic Quality:** The product is practical and functional overall.

- **Simplicity:** The product is simple in operation.
- **Social Influences:** Interacting with the product helps the user to socialize or present themselves in a favorable way.
- **Stimulation:** Working with the product encourages the user to work with it again and again.
- **Trust/Credibility:** The product appears trustworthy to the user.

From the panel of experts, five additional factors were proposed. Except for the factor Relevance, we have given a reference for each additional factor, which we researched following the suggestion of the panel of experts: *Convenience* [Ladhari 2010], *Fun* [Hassenzahl et al. 2001], *Intuitive Operation* [Naumann et al. 2007], *Relevancy* and *Social Influences* [Whitworth and Ahmad 2013].

User experience is generally understood as a multidimensional construct [Boy 2017]. For example, in order to obtain a good user experience, a product should be easy to learn, efficient to use or well controlled with additional criteria like aesthetics, joy-of-use, novelty or attractiveness.

The presented factors partly overlap. This is because they partly measure different aspects or emphases. They cannot be completely separated from each other. We have also not examined whether the list of UX factors is complete in the sense of the definition of UX.

3.2.4 Allocation of Factors to Questionnaires

Allocating consolidated factors to the analyzed questionnaires is based on the assumption that the factors mean and/or express the same. We have analyzed the factors of the individual questionnaires on the factor level and consolidated them. Due to the different items, we have not conducted any analysis of the items per factor and questionnaire. For example, the SUMI questionnaire contains the factors Global, Learnability, Helpfulness, Controllability, Affect and Efficiency. The factor Global includes the item of *"I enjoy my sessions with this software."* Based on its meaning, this item can be allocated to the *"Fun"* factor, but this is not included in the questionnaire. Another example from SUMI is the item of *"The software has a very attractive presentation"* (factor Global), which can be allocated to the meaning of the *"Appearance/Attractiveness"* factor. This factor is not included in the SUMI questionnaire either. In Table 3, the consolidated factors were allocated to the questionnaires.

The two factors of *Controllability/Dependability* and *Learnability/Perspicuity* are the factors used most frequently. This is due to the fact that they are usability criteria. *Appearance and/or Attractiveness* are measured by all of the user experience questionnaires, but not the usability questionnaires.

Factor	**SUS**	**QUIS**	**PUEU**	**SUMI**	**IsoNorm**	**PSSUQ**	**PUTQ**	**IsoMetrics**	**AttrakDiff2**	**UEQ**	**VisAWI**	**meCUE**	**SUPR-Q**	**Occurrence**
Controllability/Dependability		X		X	X	X	X	X		X				**7**
Learnability/Perspicuity		X		X	X	X	X	X		X				**7**
Helpfulness			X	X	X	X		X				X		**6**
Appearance/Attractiveness									X	X	X	X	X	**5**
Efficiency				X			X			X		X		**4**
Overall	X	X		X								X		**4**
Flexibility					X		X	X						**3**
Completeness					X			X						**2**
Emotion/Affect				X								X		**2**
Identity									X			X		**2**
Loyalty												X	X	**2**
Pragmatic Quality									X				X	**2**
Simplicity		X									X			**2**
Stimulation									X	X				**2**
Craftsmanship											X			**1**
Ease of use			X											**1**
Immersion												X		**1**
Novelty										X				**1**
Originality											X			**1**
Trust/Credibility													X	**1**
Convenience														**0**
Fun														**0**
Intuitive Operation														**0**
Relevancy														**0**
Social Influences														**0**
Number of Factors	**1**	**4**	**2**	**6**	**5**	**3**	**4**	**5**	**4**	**6**	**4**	**8**	**4**	

Table 3: User experience questionnaires with their factors

4 Study 2 for RQ2: Are there differences between the perceived importance of UX factors for different products?

In this case study, products with a high level of awareness were evaluated to ensure the subjects could assess the products. The test objects selected were *Facebook*, *Firefox Browser*, *Outlook*, *Skype*, *Wikipedia*, and *Youtube*.

The study aimed to determine the perceived importance of each factor for each test product. The result should serve as a basis for a comparison with the factors determined in the questionnaires. The analysis should show which questionnaire fits better the test product and which does not. It was not the object of the study to measure or evaluate usability or user experience. Finally, we figure out which questionnaire covered the most important UX factors identified and consolidated from RQ1.

The study was conducted at the University of Applied Sciences Emden/Leer with 61 participants. All 61 participants were master's students and attendees of the User Experience module. They knew the definition of user experience and the impact on product development. The participants were asked to complete a readymade Excel sheet consisting of a matrix with all the test objects and all consolidated factors from Section 3.2.3. Each factor was given its name and a description from Section 3.2.3, so that incorrect interpretations of the factors could be reduced.

Seven well-known products were offered, from which the participants had to choose a product they knew very well. The participants had to choose a product with which they had had regular experience. If the participants had to evaluat all seven products, it would have taken too much time. There would have been a risk that the participants would not know the products well enough or would give inaccurate information at the end due to the long evaluation.

For each factor, the participants now had to indicate how important the factor and/or product quality is to them for the selected product (-3: not important at all to +3: very important). More, the participant should write why they made the selection. This should serve to ensure that the respondent carries out the selection conscientiously. If the factor could not be mapped to the test object or if the participant was not supposed to specify the importance, the participant should not specify anything. The participants were asked to make their assessments based on the past and not immediately after interacting with the product. The purpose of this was to ensure the participants were not in the usage mode or the activity mode to avoid excessive evaluation of the hedonic or pragmatic quality aspects [Hassenzahl et al. 2002]. No course credits or benefits were awarded for participation.

As a result, we have a value for the perceived importance for each participant, factor, and test object.

The study did not take the factors of *Emotion/Affect*, *Overall* and *Pragmatic Quality* into account. This is due to the fact that while the factors are measured by questionnaires, they are too general in scope for the study, i.e. they leave too much space for interpretation and cannot be clearly divided from other factors. For instance, the *Overall* factor of the SUS questionnaire contains items that measure *Learnability/Perspicuity* and *Efficiency*. This implies that the *Overall* factor is ultimately a blend of both factors.

Factor	Amazon		Facebook		Firefox		Outlook		Skype		Wikipedia		Youtube	
Appearance/Attractiveness	↑ 2,1	1,6	↑ 1,1	1,7	↑ 1,9	1,2	↑ 1,1	1,6	↑ 1,5	1,5	↑ 2,5	0,7	↑ 2,1	1,3
Completeness	↑ 1,5	1,0	↑ 1,5	1,3	↓ -1,1	1,0	→ 0,4	0,7	→ 0,3	0,8	↓ -1,5	0,0	↑ 2,2	1,1
Controllability/Dependability	→ -0,3	0,7	→ -0,9	1,7	→ -0,9	1,4	→ -1,0	0,8	→ -0,8	2,6	→ -1,0	1,4	→ 0,1	1,1
Convenience	↑ 2,5	1,0	↑ 1,2	1,5	↑ 1,8	2,2	↑ 2,6	0,4	→ 0,8	1,4	↑ 1,0	0,7	↑ 1,8	1,7
Craftmanship	↑ 2,7	1,0	→ 0,2	1,6	↑ 2,3	1,9	↑ 3,0	1,1	→ -0,3	1,0	→ -1,0	2,8	→ 0,6	1,0
Ease of Use	→ 0,7	1,1	↑ 1,5	0,5	→ 0,0	2,0	↑ 1,0	0,5	→ 0,5	1,3	→ -0,5	2,1	↑ 2,3	0,9
Effiency	↑ 2,1	1,1	↑ 1,6	1,0	→ 0,5	2,1	↑ 2,1	1,0	↑ 1,3	1,3	→ 0,0	0,0	↑ 1,9	0,9
Flexibility	↑ 2,1	2,1	↑ 1,5	2,2	↑ 1,9	2,0	↑ 2,1	0,8	↑ 2,0	2,1	↑ 3,0	0,7	↑ 1,3	1,7
Fun	↑ 1,4	1,5	↑ 1,2	1,3	→ -0,3	1,1	→ 0,1	1,3	↓ -1,3	2,6	→ 0,0	2,1	↑ 1,3	1,2
Helpfullness	→ -0,3	0,7	→ 0,2	2,0	→ -0,5	1,9	→ -0,6	0,5	↓ -1,3	1,3	↓ -2,0	1,4	→ 0,6	1,8
Identity	↑ 1,9	1,6	↑ 2,4	2,0	↑ 1,6	2,1	↑ 2,6	1,9	↑ 1,8	2,1	→ 0,5	0,0	↑ 2,2	2,4
Immersion	↑ 2,5	2,2	↑ 1,8	2,0	↑ 1,6	2,1	↑ 2,0	0,8	↑ 1,8	1,3	↑ 3,0	0,7	↑ 2,4	1,4
Intuitive Operation	→ 0,2	0,9	→ 0,3	1,7	↑ 1,1	1,4	↑ 1,3	1,2	→ 0,5	2,4	↓ -2,5	0,7	→ -0,4	0,8
Learnability/Perspicuity	↑ 2,4	1,0	→ 0,8	1,3	↑ 1,3	2,0	↑ 2,9	1,3	↑ 2,0	1,0	↑ 1,5	0,7	↑ 1,6	0,9
Loyalty	↑ 2,3	1,5	↑ 1,3	2,5	↑ 1,8	2,3	↑ 2,4	1,6	→ 0,5	1,3	↑ 1,0	1,4	↑ 1,9	1,8
Novelty	↑ 2,3	1,6	↑ 1,2	1,8	↑ 1,3	1,6	↑ 2,7	1,0	↑ 1,5	1,7	→ 0,0	1,4	→ 0,4	2,1
Originality	→ 0,1	1,6	→ 0,8	1,5	↓ -1,5	1,4	↓ -1,7	1,1	↓ -1,5	1,0	→ -0,5	0,0	↑ 1,4	1,7
Relevancy	→ 0,7	0,5	→ 0,0	0,9	→ 0,1	2,3	→ 0,6	0,0	→ 0,3	2,6	↓ -1,5	3,5	→ 0,4	0,8
Simplicity	↑ 2,7	0,9	↑ 2,3	1,6	→ -0,3	1,8	↑ 3,0	0,8	→ 0,0	2,4	→ 0,5	0,0	↑ 2,3	0,9
Social	↑ 2,1	2,0	↑ 1,9	0,9	→ 0,9	1,1	→ 0,9	1,9	↑ 1,3	2,9	↑ 1,5	0,0	↑ 1,9	2,3
Stimulation	→ -0,5	1,3	↓ -1,2	1,2	↓ -1,8	2,0	↓ -1,3	1,5	↓ -1,8	2,5	↓ -2,0	0,7	→ -0,1	0,9
Trust/Credibility	↓ -1,3	0,7	↑ 2,7	2,4	↓ -1,5	1,4	→ 0,1	0,0	↑ 1,3	3,2	↓ -3,0	2,8	→ 0,1	1,8

Figure 1: Mean values and standard deviation per factor and product

61 participants took part and evaluated the following products: Amazon N_A=15 (5female, 10male), Facebook N_{Fa}=13 (1f, 12m), Youtube N_Y=12 (2f, 10m), Firefox N_{Fi}=8 (0f, 8m), Skype N_S=4 (0f, 4m), MS Outlook N_O=7 (1f, 6m) and Wikipedia N_W=2 (1f, 1m). Each participant only evaluated one product.

4.1 Results of Study 2

4.1.1 Importance of Factors

Fig. 1 shows the grouping, arithmetic mean and standard deviation for each factor and product. For better readability, they were grouped into three areas: not important (red/down arrow, range between -3 and -1), neutral (yellow/right arrow, range between -1 and +1), and important (green/up arrow, range between +1 and +3).

The sample size of the study is very small. But the mostly small standard deviation tends to show a common understanding among the participants. In order to interpret the data, however, the high standard deviation is secondary in this case. The aim of the study is not the absolute result for the importance of each factor, but whether the factor was assessed as rather important, neutral or not important.

The results show that some factors were evaluated as important for all or almost all of the products (see Fig. 1), for example, Appearance / Attractiveness, Convenience, Efficiency, Flexibility, Identity, Immersion, Learnability / Perspicuity, Loyalty, Novelty, and Social Influences. Other factors, in contrast, were not considered important, such as Controllability / Dependability and Stimulation.

4.1.2 Common Factors

The results of this study have shown that the participants assessed different factors as important or not important for different products. Examining only the factors considered important (range between +1 and +3), this results in a list of important factors per product as follows:

- **Amazon:** Appearance / Attractiveness, Completeness, Convenience, Craftsmanship, Efficiency, Flexibility, Fun, Identity, Immersion, Learnability / Perspicuity, Loyalty, Novelty, Simplicity, Stimulation and Social Influences.
- **Facebook:** Appearance / Attractiveness, Completeness, Convenience, Ease of use, Efficiency, Flexibility, Fun, Identity, Immersion, Loyalty, Novelty, Simplicity and Social Influences.
- **Firefox:** Appearance / Attractiveness, Convenience, Craftsmanship, Flexibility, Identity, Immersion, Intuitive Operation, Learnability / Perspicuity, Loyalty and Novelty.
- **Outlook:** Appearance / Attractiveness, Convenience, Craftsmanship, Ease of use, Efficiency, Flexibility, Identity, Immersion, Intuitive Operation, Learnability / Perspicuity, Loyalty, Novelty and Simplicity.
- **Skype:** Appearance / Attractiveness, Efficiency, Flexibility, Identity, Immersion, Learnability / Perspicuity, Novelty and Social Influences.
- **Wikipedia:** Appearance / Attractiveness, Convenience, Flexibility, Immersion, Learnability / Perspicuity, Loyalty and Social Influences.
- **Youtube:** Appearance / Attractiveness, Completeness, Convenience, Ease of use, Efficiency, Flexibility, Fun, Identity, Immersion, Learnability / Perspicuity, Loyalty, Originality, Simplicity and Social Influences.

In addition to the list of most important factors per product, the number of factors taken into account by the questionnaires presented in section 3.2.1 can be calculated per product. Table 4 illustrates the absolute number (before the slash) and percentage (after the slash). Besides the short description of the questionnaire, the number of factors of the questionnaire has been inserted in parentheses.

Since SUS only maps one factor in the form of an overall assessment and this has not been considered (see section 3.2.3), no common factors have been found. Identical results have been found for IsoNorm and IsoMetrics since they are designed in a similar way [Prümper and Anft 1993, Gediga et al. 1999]. The

Product	**SUS (1)**	**QUIS (4)**	**PUEU (2)**	**SUMI (6)**	**IsoNorm (5)**	**PSSUQ (3)**	**PUTQ (4)**	**IsoMetrics (5)**	**AttrakDiff2 (4)**	**UEQ (6)**	**VisAWI (4)**	**meCUE (8)**	**SUPR-Q (4)**
Amazon	0/0	2/50	0/0	2/33	3/60	1/33	3/75	3/60	2/50	4/67	3/63	5/63	2/50
Facebook	0/0	1/25	1/50	1/17	2/40	0/0	2/50	2/40	2/50	3/50	2/63	5/63	3/75
Firefox	0/0	1/25	0/0	1/17	2/40	1/33	2/50	2/40	2/50	3/50	2/50	4/50	2/50
Outlook	0/0	2/50	1/50	2/33	2/40	1/33	3/75	2/40	2/50	4/75	3/63	5/63	2/50
Skype	0/0	1/25	0/0	2/33	2/40	1/33	3/75	2/40	2/50	4/25	1/50	4/50	2/50
Wikipedia	0/0	1/25	0/0	1/17	2/40	1/33	2/50	2/40	1/25	2/25	1/38	3/38	2/50
Youtube	0/0	2/50	1/50	2/33	3/60	1/33	3/75	3/60	2/50	3/75	3/50	4/50	2/50
Total	0/ 0%	10/ 6%	3/ 21%	11/ 26%	16/ 45%	6/ 29%	18/ 64%	16/ 45%	13/ 46%	23/ 55%	15/ 54%	30/ 54%	15/ 54%

Table 4: Number of factors (absolute number before the slash and percentage after the slash) measured per product and questionnaire.

highest number of common factors has been identified for meCUE, which can be attributed to the high number of factors (8) included in the questionnaire. Considering the percentages for the numbers of factors, the picture looks a little different. The highest percentage of common factors is mapped by PUTQ (64%).

5 Discussion

Finally, none of the questionnaires contains all of the factors. Each of them only covers partial aspects of user experience. This also implies that potentially important and/or necessary factors for a test object are not inquired.

Both the number and diversity of the factors lead to the assumption that not all factors apply to all products and/or product groups in equal measure. For instance, the "*Trust/Credibility*" factor is more important, for safety-related products such as online banking, control software, etc. than for Youtube or Amazon, for example [Yeung 2006, Springett and French 2007].

Section 3 listed all factors that were determined by products or product groups. For example, the factor Social Influences was identified in a long-term study [Sahar et al. 2014]. However, this factor is not present in any of the common questionnaires. This aspect is not covered in an evaluation of a product with the questionnaires presented in this article. Thus possible improvement potentials of the product cannot be determined. The list of factors from the first study is as complete as possible in the context of UX questionnaires.

In the second study, well known and rather straightforward products were evaluated. For other products, such as business software, the importance of Controllability/Dependability, for example, is expected to be higher. It can also be expected that the *Stimulation* will be considered more important for games, for instance. Therefore, the indication of importance of the factors depends on the test object and cannot be universally valid.

From the two studies, it can be concluded that the questionnaires examined are not all equally suitable for the products examined. Some questionnaires cover more of the factors considered important by the participants than others. How this has a certain general validity cannot be deduced from the two studies. Also, perceived importance is just one aspect of choosing the best factors for a user experience or usability evaluation.

6 Conclusions and Future Work

With our two studies, we have been able to show that none of the established questionnaires can measure user experience to its full extent, and that employing the studied questionnaires is not equally reasonable for all products. A questionnaire is always limited to the factors it measures. It is important to bear in mind that the user will not consider each factor equally important for each product. Therefore, when selecting a questionnaire to evaluate a specific product, it must be clarified early on whether this questionnaire is suitable or not. Ideally, the questionnaire should measure all the factors the user considers important. To this end, the factors could be evaluated beforehand.

In today's practice, a questionnaire therefore often considers factors the user does not perceive as important. On the other hand, factors the user does perceive as important are missing. This means that content validity according to classical test theory is no longer the case [Nunnally and Bernstein 2010] since otherwise, all items of the questionnaire should account for the test object and/or product completely and conclusively. Of course, a questionnaire can be used with reasonable effect in practice even if not all the necessary factors are taken into account. The results of our study can assist in highlighting the problems associated with this. Furthermore, questionnaire authors should point out that their questionnaire is not equally suitable for all products and therefore has limitations. A possible solution, however, is a modular questionnaire which can be adapted to each evaluation regarding the factors used. This allows the factors that match the product to be selected for each evaluation.

A more extensive study of future research should be conducted to verify the results of this study. The results of Table 4 indicate that there might be some basic factors. A basic factor is a factor that, as far as possible, covers a wide spectrum of products and is therefore as generally valid as possible. In addition, further products and/or product groups should be analyzed to incorporate a wider spectrum of products.

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