

Springer Series in Design and Innovation 13

Özge Cordan · Demet Arslan Dinçay ·  
Çağıl Yurdakul Toker · Elif Belkıs Öksüz ·  
Sena Semizoğlu *Editors*

# Game + Design Education

Proceedings of PUDCAD 2020

 Springer

# Springer Series in Design and Innovation

Volume 13

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Çağıl Yurdakul Toker · Elif Belkıs Öksüz ·  
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Editors

# Game + Design Education

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ISSN 2661-8184

ISSN 2661-8192 (electronic)

Springer Series in Design and Innovation

ISBN 978-3-030-65059-9

ISBN 978-3-030-65060-5 (eBook)

<https://doi.org/10.1007/978-3-030-65060-5>

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# Preface

Project PUDCAD stands for *Practicing Universal Design Principles in Design Education through a Cad-Based Game*, and it is representing one of the foremost priorities of European commission: applying the inclusion and efficient accessibility for people with disabilities into everyday life.

The project was designed to work towards a major purpose through a minor addition in design education between September 2017 and 2020. PUDCAD deals with undergraduate design education to trigger the awareness of accessibility and let future designers and architects to develop accessible and innovative design ideas. It involves a design game on a CAD-based platform, allowing students to learn about basic and advanced universal design principles and train them with an entertaining context.

Istanbul Technical University proudly coordinated this project for 3 years. We developed this project with our partner universities and NGOs; Bahçeşehir University, İstanbul, Turkey; Institute of Design and Fine Arts, Lahti, Finland; Politecnico di Milano, Milano, Italy; University of Florence, Florence, Italy; University of Applied Science and Arts, Detmolder, Germany; The Association for Well-being of Children with Cerebral Palsy, Ankara, Turkey; and The Occupational Therapy Association of Turkey, Ankara, Turkey. In this term, we made lots of collaborations such as international and local workshops and conferences with our project partners to develop the main outputs of the project. We would like to thank to all of our partners for their valuable contributions. We would like to extend our thanks to the Rectorate of ITU and EU National Agency for their support in the administering works of the project and also special thanks to Efe Can Arslan. He and his friends, as brilliant young people with cerebral palsy, became the muses of this project.

As part of PUDCAD Project, the “PUDCAD Universal Design Practice Conference: Game + Design Education” international conference (E5) was organized by ITU-PUDCAD Team between 24 and 26 June 2020. Due to the global pandemic of COVID-19, the conference was held online through zoom. The conference, which was focused on the dissemination and promotion of the developed game and pre-launching of E-learning courses of the PUDCAD Project, aimed to open up to discussions the studies regarding the conference topics as “Universal Design”, “Game and Design Studies” and “E-Learning in Design Studies”.

Under these three main topics, the 33 papers under nine sessions were presented in three days. We would like to thank Hülya Kayıhan, Gonca Bumin, Güven Çatak, Birgül Çolakoğlu, Çetin Tüker, Barbaros Bostan, Çakır Aker, Veli-Pekka Rätty and Aslıhan Ünlü Tavil for chairing the sessions in the specified order; “Universal Design and Education”, “Universal Design and User Experience”, “Games for Change”, “Game Design Experiment”, “Virtual Reality Experiment I”, “Virtual Reality Experiment II”, “Playful Experience Design”, “Playful Spaces and Interfaces” and “Gamification and E-Learning in Design”.

Besides, we hosted five keynote speakers from different disciplines and from a different expertise in each day. In the first day, Fiemmetta Costa from PUDCAD Partner University POLIMI spoke about “The Principles of Universal Design in PUDCAD Project Development” and Güven Çatak and Çetin Tüker from PUDCAD Partner University BAU introduced the PUDCAD Game in their speech about “Developing a CAD-Enriched Empathy Experience for Universal Design Principles: Journey of the PUDCAD Game”. In the second day, Christopher Holmgård, who is co-owner of Die Gute Fabrik, spoke about “AI (eyay) Personas for Designing, Testing, and Optimizing Games” and Dylan Yamada Rice, from Royal College of Art, gave her speech about “Children and VR” sequentially. In the third day, Francesca Tossi as PUDCAD Partner University, UNIFI, gave her speech about “Asking Users: Questionnaires and Interviews as Indirect Observation Tools in Human-Centred Design Approach”.

We believed that the “PUDCAD Universal Design Practice Conference: Game + Design Education Conference” has contributed to the creation of a discussion platform for academicians, students, relevant stakeholders and professionals from different areas of expertise for future research inquiries and relationships. Furthermore, we hope that the 32 studies presented at the conference and included in the proceedings book contribute to widen our perspectives in all senses.

Istanbul, Turkey  
 Istanbul, Turkey  
 Singapore, Singapore  
 Istanbul, Turkey  
 Istanbul, Turkey

Özge Cordan  
 Demet Arslan Dinçay  
 Çağıl Yurdakul Toker  
 Elif Belkıs Öksüz  
 Sena Semizoğlu

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# Asking Users. Questionnaires as Indirect Observation Tools in Human-Centred Design Approach. Application Cases



Francesca Tosi, Antonella Serra, Alessia Brischetto, and Giovanna Nichilò

**Abstract** Human-Centred Design (HCD) investigation and assessment methods record the user's needs and satisfaction level and are widely used to evaluate usability and orientate design decision making. Questionnaires are among the most useful and popular observation tools to study users' opinions using quantifiable and comparable data. Their drafting needs requirements and evaluations in order to use them efficiently. Therefore, this paper intends to provide designers and researchers with useful tips for designing these tools. For this reason, it describes features of method and systematizes instructions from the literature. It also shows application cases to exemplify the relationship between method and type of data collected and to explore impacts of using different types of questionnaires in design processes.

**Keywords** Human-Centred Design · Questionnaire · Indirect observation · Usability · Tools

## 1 Introduction

Usability is defined as “extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” [8]. Usability evaluation involves user participation and uses Human-Centred Design (HCD) investigation and assessment methods [9] that record the user's needs and satisfaction level. This design approach aimed at the

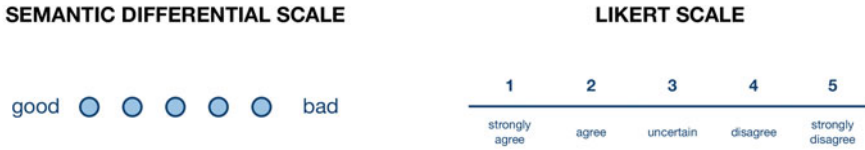
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**Fig. 1** Semantic differential scale and Likert scale

quality of interaction between people and physical or virtual systems with which they relate. It is based on data and information collection and processing to understand people’s needs and expectations in the relationships they establish with a system, product or service which they interact [18].

Therefore, collecting and processing information derived from the user is a fundamental step in orienting design choices and evaluating the usability of systems.

For this reason questionnaires are among the most useful and popular tools to achieve this goal. These tools are defined as indirect observation methods since they not study the system itself but the users’ opinions about it [10].

This paper describes features of method and explores impacts of the use of different kinds of questionnaires in design processes for: (a) the definition of system/product requirements, (b) the validation of design solutions.

The paper also intends to systematize instructions from the literature that are useful for drafting these tools for designers and researchers; it also shows application cases—from research activities of the Laboratory of Ergonomics and Design (LED)<sup>1</sup> of the University of Florence—to exemplify the relationship between method and data type collected.

## 2 Questionnaires. Features and Uses

A questionnaire is a structured set of questions that are submitted by an evaluator or researcher to the user to record his/her opinion on a product or system.

The choice of a specific type of question must be carefully evaluated by the evaluator/researcher depending on the data he wants to get from the user.

Usually questionnaires consist of closed questions, by which the user provides univocal data, identified on a scale or in a list of options. This type of question generates quantitative and comparable data.

In contrast to this type, open-ended questions—even if they allow the user to express opinions in a personal way that may be relevant for the researcher—generate data that cannot be quantified and not directly comparable and also, as stated by Nielsen [10], can produce answers that are difficult to interpret or “non-answers”.

Especially useful for usability studies are questionnaires that use the Likert scale and semantic differential scales (Fig. 1):

<sup>1</sup><https://www.ergonomicsdesignlab.com>.

- (a) Likert scale offers the user the choice of the answer with respect to a range of pre-formulated statements;
- (b) Semantic differential scales use evaluation scales that identify the answer as an intermediate value between a pair of opposite attitudes or adjectives.

Both are particularly effective for usability studies and are the most used because they getting people to make a judgement about the analyzed system (e.g. how easy, how usable etc.) and later to compare the interviewees' data [11, p. 401].

## 2.1 *Likert Scale*

Likert scale is the most frequently used for products evaluation. Generally, for each questions/affirmations, answers as numerical or word marks are possible. A scale of values is associated with these where the user can identify himself and express a state ranging from “strongly dis-agree” to “strongly agree”.

The process for making a Likert scale proposed by Guidicini [7, p. 76] is interesting. He explains that the construction of scale depends on the number of options in which you want, and it is possible, to break down a concept; to do this it is necessary to carefully identify all the sub-sets in which you can break down the concept that generates scale, reduce them to a reasonably low number and isolate the most significant ones. These concepts determine the number and type (numerical, textual, etc.) values used in the scale.

Most questionnaires use 7- or 5-point scales, but there are also examples of more compact (3-point) or larger scales. It is clear that a more large scale allows to pick more shades in the user evaluation, while a more compact scale focuses the data collection on a smaller number of items: therefore, the most fitting scale is the one that best responds to the goal defined at the beginning of the data collection and to its application.

A scale of odd numbers gives the user the possibility to indicate a neutral position with respect to two endpoints, instead, an even number forces interviewees to make a decision and indicate a value that expresses a stronger proximity to an opposite concept.

The **Quebec User Evaluation of Satisfaction with Assistive Technology—QUEST** (Fig. 2) is an example of 5-point scale. It is an assistive technology (AT) user satisfaction assessment tool used both for clinical field—as it allows clinicians to document the real benefits of AT and to validate the need for these devices—and as a research tool because it compares satisfaction data with other outcome measures such as clinical outcomes, quality of life, functional status, cost factors and comfort [5, p. 102].

QUEST includes 12 questions related to product features and divided into two section:

- a. 8 questions that evaluate the Satisfaction Level of “Assistive Device”;
- b. 4 questions that evaluate the Satisfaction Level of “Services”.

1	2	3	4	5
not satisfied at all	not very satisfied	more or less satisfied	quite satisfied	very satisfied

ASSISTIVE DEVICE				
<i>How satisfied are you with,</i>				
1. the <b>dimensions</b> (size, height, length, width) of your assistive device? <i>Comments:</i>			1	2 3 4 5
2. the <b>weight</b> of your assistive device? <i>Comments:</i>			1	2 3 4 5
3. the <b>ease in adjusting</b> (fixing, fastening) the parts of your assistive device? <i>Comments:</i>			1	2 3 4 5
4. how <b>safe and secure</b> your assistive device is? <i>Comments:</i>			1	2 3 4 5
5. the <b>durability</b> (endurance, resistance to wear) of your assistive device? <i>Comments:</i>			1	2 3 4 5
6. how <b>easy</b> it is to use your assistive device? <i>Comments:</i>			1	2 3 4 5
7. how <b>comfortable</b> your assistive device is? <i>Comments:</i>			1	2 3 4 5
8. how <b>effective</b> your assistive device is (the degree to which your device meets your needs)? <i>Comments:</i>			1	2 3 4 5
SERVICES				
<i>How satisfied are you with,</i>				
9. the <b>service delivery</b> program (procedures, length of time) in which you obtained your assistive device? <i>Comments:</i>			1	2 3 4 5
10. the <b>repairs and servicing</b> (maintenance) provided for your assistive device? <i>Comments:</i>			1	2 3 4 5
11. the quality of the <b>professional services</b> (information, attention) you received for using your assistive device? <i>Comments:</i>			1	2 3 4 5
12. the <b>follow-up services</b> (continuing support services) received for your assistive device? <i>Comments:</i>			1	2 3 4 5

© L. Demers, R. Weiss-Lambrou & B. Ska, 2000

Fig. 2 QUEST—Quebec. Source Demers et al. [4]

Each question is associated with a “comments” area where the user has the possibility to record further opinions and input in a more free format.

At the end of the questions, the user is asked to indicate the three aspects/services of the device that he personally considers most important. In this way, the interviewer obtains both an analytical evaluation of each item and the user’s priorities about the device.

Even if it is a synthetic questionnaire, the articulation in sections is important because it allows users to be more oriented when formulating the evaluation, making a distinction between what impressions, expectations, values are associated with each item analyzed, and reducing overlaps and interferences.

This structure is correctly understood by users when the sections are clearly distinct, not only in terms of content, but also through graphic and compositional elements that consolidate the user’s perception of the responses’ subdivision (see Fig. 2).

Another important QUEST feature is its versatility. In fact it is structured to be compiled in autonomy by users but, if this way is not suitable, also to be supplied in interview format or using 12 satisfaction cards—made by modifying the layout, printing and cutting out the 12 items—by which the user can express orally, or just indicate, his opinion. Variability of the support and the administration format allows to involve a wider number of users, including users with motor, cognitive or sensory disabilities.

To follow some application cases developed at the Laboratory of Ergonomics and Design (LED) of the University of Florence.

The first one concerns the UX Skillrow Evaluation,<sup>2</sup> conducted in collaboration with Technogym s.p.a. [17], which aimed to define usability and user experience levels of a new company product—“Skillrow” rowing machine—and its user interfaces.<sup>3</sup>

Users were involved in a four-day program of activities, during which different HCD methodologies were applied in synergy:

- (a) during the first two days, users’ opinions on critical issues and/or benefits found during UX were recorded, using both direct and indirect observation methods: thinking aloud and post-use questionnaire on the first day; focus group on the second day;
- (b) the following days were dedicated to their representation and visualization by methodologies such as Task Analysis, Personas and Scenarios (days 3–4).

Overall the data obtained derives from an integrated use of different HCD methodologies, each of which is characterized by a different way of collecting and processing data.

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<sup>2</sup>SKILLROW Team: Francesca Tosi (Scientific Coordinator), Alessia Brischetto, Mattia Pistolesi, Ester Iacono, in collaboration with Technogym Research Center.

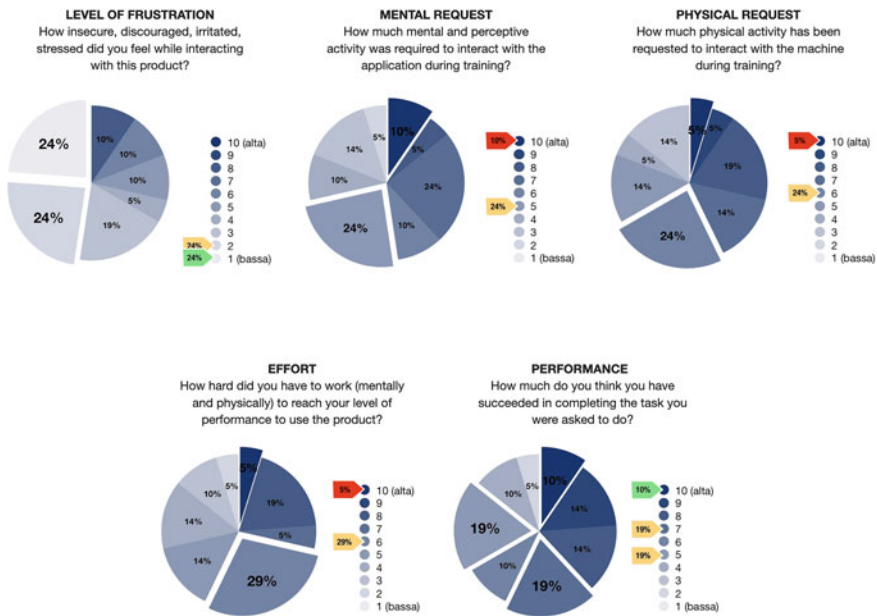
<sup>3</sup>See Brischetto [2].



The post-use questionnaire of this research was structured in three blocks: (1) Personal Data (5 questions); (2) User Experience (10 questions); (3) Understanding (21 questions). Each one is characterized by different types of questions:

- *Personal Data Questionnaire* is aimed to define the user profile and uses closed-choice questions with a predefined number of answer options set by the interviewer;
- *Understanding Questionnaire* is aimed to record the difficulties in the use of the machine and the interface and the understanding of the commands and instructions by the user. It uses questions with only two alternative answers, of the yes/no type;
- *UX Questionnaire* quantifies the different aspects of the user experience through a 10-points Likert scale. By this questionnaire the user evaluates 5 issues both Machine and Interface: (1) Level of Frustration, (2) Mental Request; (3) Physical Request; (4) Effort; (5) Performance.

Each questionnaire used a different type of questions depending on the data to be processed, outlining user profiles (Personal Data Questionnaire) and providing qualitative data on the actual usability levels of the product, its components and the graphical user interface (Understanding and UX Questionnaire) (Fig. 3).



**Fig. 3** UX Skillrow evaluation. Results of experience of use questionnaires—interaction with machine [2]

The second application case concerns the PUDCAD<sup>4</sup> research project, a three-year Strategic Partnership project financed by European Erasmus + programme.

PUDCAD involves an Educational Game [12] design to introduce Design Students to Universal Design and the design, together with the game, of a dedicated website including a Game tutorial and an e-learning course for learning Universal Design.

During the three years of activity more than one hundred students from the six partner universities have been involved by four international workshops. Their involvement both as designers and end users has created a particularly intense and authentic Human Centred Design (HCD) teaching and design experience, given the correspondence of the two profiles [16].

Following are some examples of questions from the questionnaire submitted to a sample of 12 students in the preliminary design phase of the Game Tutorial.

Purpose of the questionnaire was to evaluate effectiveness of information offered to users by a tutorial external to the game, which can be consulted before the game session, without compromising motivation to play the game, maybe feed it.

**Example 1** Users were asked to evaluate how much the tutorial content they were shown caused: (a) Curiosity; (b) Interest; (c) Challenge; (d) Empathy—dimension through which the motivation is expressed.

Users expressed their evaluation by a 5-point Likert scale, according to which a numerical score of 0–4 corresponded respectively to evaluations between “strongly disagree”—“strongly agree”. Figure 4 shows question/answer formulation (3a) and processing of collected data (3b).

The question formulated in this way allowed to clearly deduce that having introduced the use of the PUDCAD Game by an external Tutorial—a solution increasingly less common among videogames—did not decrease the motivation to play the game by the sample of students interviewed, which on the contrary showed a high motivation.

**Example 2** Users were asked to evaluate the tutorial contents submitted to them on a 7-point semantic differential scale. Each of the eight components evaluated—(a) Contents, (b) Example, (c) Language, (d) Wording, (e) Information sequence, (f) Graphical representation, (g) Text, (h) Keywords—is combined with a pair of adjectives that aim to record a user evaluation of clarity, effectiveness, completeness and readability of information. Figure 5 shows the structure of the question and the results obtained from data processing.

Question 5 results indicate mostly positive values (5, 6, 7) for all investigated items, but highlight areas where the user shows less satisfaction or uncertainty.

These data, combined with those obtained from short interviews following the questionnaire, have provided new input for a review of the design elements.

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<sup>4</sup>PUDCAD Team: Francesca Tosi (Scientific Coordinator), Antonella Serra, Alessia Brischetto, Ester Iacono.

3. The information you've received makes you feel about the game:

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
	4	3	2	1	0
Curiosity					
Interest					
Challenge					
Empathy					

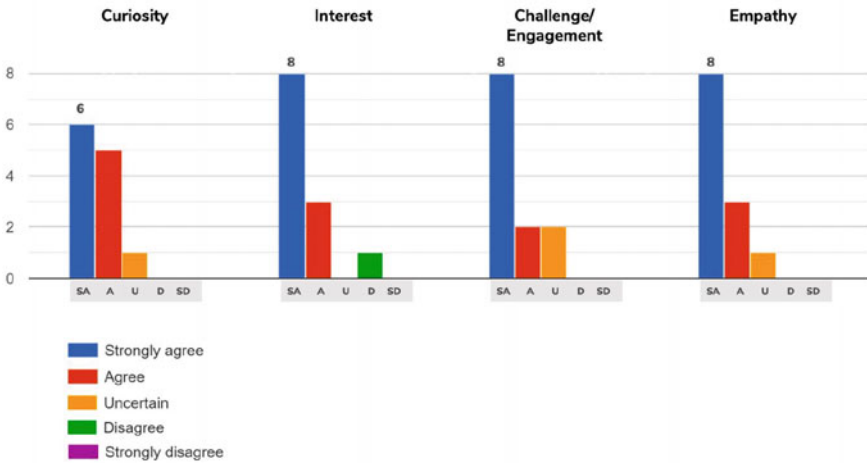


Fig. 4 Tutorial questionnaire 1, Question 3: Formulation of question (3a) and results processing (3b)—[16]

## 2.2 Semantic Differential Scale

Using semantic differential scales, users base their evaluation expressing a status of semantic proximity in a range of two bipolar concepts. Each pair is represented by two opposing adjectives and the user is asked to express his position with respect to the two poles to indicate how much he agrees with the formulated concept.

The User Experience Questionnaire—UEQ [19] is an internationally accepted example of semantic differential scale application. It is a questionnaire dedicated to User Experience evaluation of interactive products (Fig. 6).

The current questionnaire version contains 26 items related to 6 scales: Attractiveness—Perspicuity—Efficiency—Dependability—Simulation—Novelty—about which Schrepp et al. [15] explain: “Attractiveness is a pure valence dimension. Perspicuity, Efficiency and Dependability are pragmatic quality aspects

5. How do you evaluate the following (indicate a value):

		1	2	3	4	5	6	7	
Contents	Poor								Exhaustive
Examples	Effective								Ineffective
Language	Complicated								Simple
Wording	Clear								Confused
Information sequence	Ineffective								Effective
Symbols, icons, other graphical representation	Intuitive								Unintuitive
Text	Readable								Not readable
Keyword	Effective								Ineffective

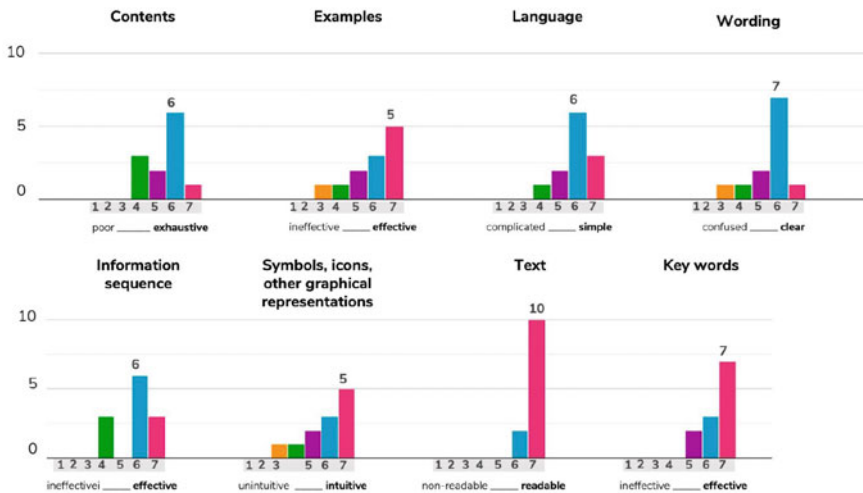


Fig. 5 Tutorial questionnaire, Question 5: Formulation of question (5a) and results processing (5b)—[16]

(goal-directed), while Stimulation and Novelty are hedonic quality aspects (not goal-directed)”.

Users express their opinion by a 7-point semantic differential scale. Both the order of the items and the disposition on the right or left of the terms that make up the pair is randomized.

For semantic differentials it is especially important that participants have access to appropriate content for the user target group and in their natural language. For this reason the UEQ is available in various languages and there is also a version for children and teenager in German that uses a simplified language (Table 1).

A second internationally accepted example of a questionnaire with a semantic differential scale is the Questionnaire for User Interaction Satisfaction—QUIS [3].

Please assess the product now by ticking one circle per line.

	1	2	3	4	5	6	7		
annoying	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	enjoyable	1
not understandable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	understandable	2
creative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	dull	3
easy to learn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	difficult to learn	4
valuable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	inferior	5
boring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	exciting	6
not interesting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	interesting	7
unpredictable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	predictable	8
fast	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	slow	9
inventive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	conventional	10
obstructive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	supportive	11
good	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	bad	12
complicated	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	easy	13
unlikable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	pleasing	14
usual	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	leading edge	15
unpleasant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	pleasant	16
secure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	not secure	17
motivating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	demotivating	18
meets expectations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	does not meet expectations	19
inefficient	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	efficient	20
clear	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	confusing	21
impractical	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	practical	22
organized	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	cluttered	23
attractive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	unattractive	24
friendly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	unfriendly	25
conservative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	innovative	26

Fig. 6 UEQ—user. Source UEQ website

This questionnaire is one of the most commonly used and was designed to evaluate user satisfaction in human–machine interfaces use and is one of most used. It uses a 9-point scale, and because it is a general questionnaire that will be used with a wide variety of products it also includes NA (not applicable) as a category (Fig. 7).

It consists of 12 parts that can be used in total or in parts: (1) System experience, (2) Past experience, (3) Overall user reaction, (4) Screen design, (5) Terminology

**Table 1** User experience questionnaire—UEQ: scales and items [14]

Scales	Items
<b>Attractiveness</b> Do users like or dislike the product? This scale is a pure valence dimension	Annoying/enjoyable Good/bad Unlikable/pleasing Unpleasant/pleasant Attractive/unattractive Friendly/unfriendly
<b>Efficiency</b> Is it possible to use the product fast and efficient? Does the user interface looks organized?	Fast/slow Inefficient/efficient Impractical/practical Organized/cluttered
<b>Perspicuity</b> Is it easy to understand how to use the product? Is it easy to get familiar with the product?	Not understandable/understandable Easy to learn/difficult to learn Complicated/easy Clear/confusing
<b>Dependability</b> Does the user feel in control of the interaction? Is the interaction with the product secure and predicable?	Unpredictable/predictable Obstructive/supportive Secure/not secure Meets expectations/does not meet expectations
<b>Simulation</b> Is it interesting and exciting to use the product? Does the user feel motivated to further use the product?	Valuable/inferior Boring/exiting Not interesting/interesting Motivating/demotivating
<b>Novelty</b> Is the design of the product innovative and creative? Does the product grab users attention?	Creative/dull Inventive/conventional Usual/leading edge Conservative/innovative

Reworked from Rauschenberger et al. [14, p. 40]

and system information, (6) Learning, (7) System capabilities, (8) Technical manuals and online help, (9) Online tutorials, (10) Multimedia, (11) Teleconferencing, (12) Software installation [11, p. 402].

### 3 Questionnaires: How to Do

Nielsen [10] says that “a questionnaire is a user interface in its own right”. Therefore, in order for users to interpret it correctly and carry it completely, it must meet the usability requirements; for this reason “is therefore essential that all questionnaires be subjected to pilot testing and iterative design before they are distributed to the users in large numbers”.

Guidicini [7] highlights instead the importance of language accuracy in the formulation of the questionnaire: the choice of adjectives, words, symbols or expressions that feature the question promotes the assumptions of a correct reading by the user.

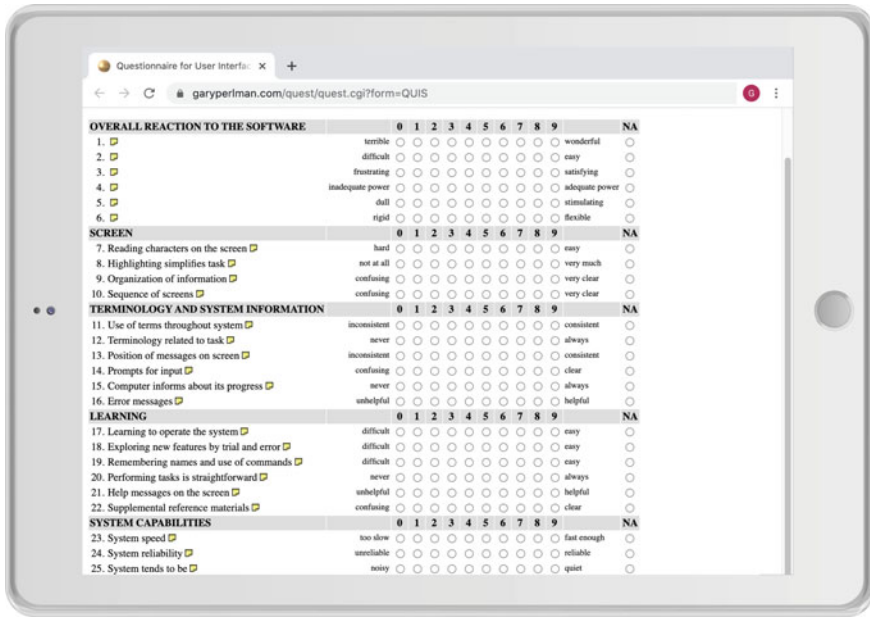


Fig. 7 QUIS—questionnaire. Source Perlman [13]

At its base, moreover, there must also be a deep knowledge of the language used by a certain culture and a certain social group.

Guidicini identifies 8 types of questions to be included in a questionnaire and for everyone it indicates the recommended formulation (see Table 2). In fact, the author affirms that it is the choice of the most appropriate type that allows users to answer.

Therefore, the evaluator/researcher has the possibility, from time to time, to structure and formulate the questionnaire according to its purpose, the target users and the way the data are collected and processed.

An important and already mentioned aspect to keep in mind when structuring a questionnaire is the division in question blocks, generally coinciding with topic groups and arranged in an order from general to particular. Following example shows the block subdivision designed for questionnaire of the XAll project.<sup>5</sup>

The project focuses on the museum field and aims to make the visit experience inclusive and performing for all target groups, including people with special needs: sensory, motor and cognitive disabilities and/or socio-cultural.

XAll Questionnaire (Fig. 8) is a tool for evaluating museum accessibility and developed according to a Design for All approach. It includes three types of questions: (a) open-choice questions, permitting multiple answer options; (b) closed-choice questions, with only one answer option; (c) questions with only two choice

<sup>5</sup>XAll Team: Francesca Tosi (Scientific Coordinator), Antonella Serra, Alessia Brischetto, Giovanna Nichilò; project funded by Fondazione TIM [6].

**Table 2** Types of questions

Types	Features	Setting
<i>1st Type</i> <b>Targeted</b> questions about individual	Overview on condition, background, gender, education, status, job etc.	Predetermined number of questions
<i>2nd Type</i> <b>Open-choice</b> questions	Include above type questions and specific topic questions	Variable range of choice
<i>3rd Type</i> <b>Closed-choice</b> questions	On all topics!	Predetermined range of choice
<i>4th Type</i> Questions with <b>only two choices</b>	Choices of juxtaposed judgment are offered	Yes/No, True/False, Agreement/Disagreement
<i>5th Type</i> <b>Scalar choices</b> questions	More predetermined judgments are offered and placed on a scale of insensitivity	Increasing intensity of judgement (positive or negative)
<i>6th Type</i> <b>Open topic</b> questions	The interviewee is called to propose his opinion with a more or less extensive speech on a focused topic	Free opinions without restriction
<i>7th Type</i> <b>Multiple variables</b> questions	A judgement is asked on multiple answers, in several directions, from a given topic	Options on all expected directions
<i>8th Type</i> questions with <b>sentence completion</b>	One or more sentences are presented with missing elements to complete it	Adding adjectives, sentence completing

Reworked from Guidicini [7], p. 19

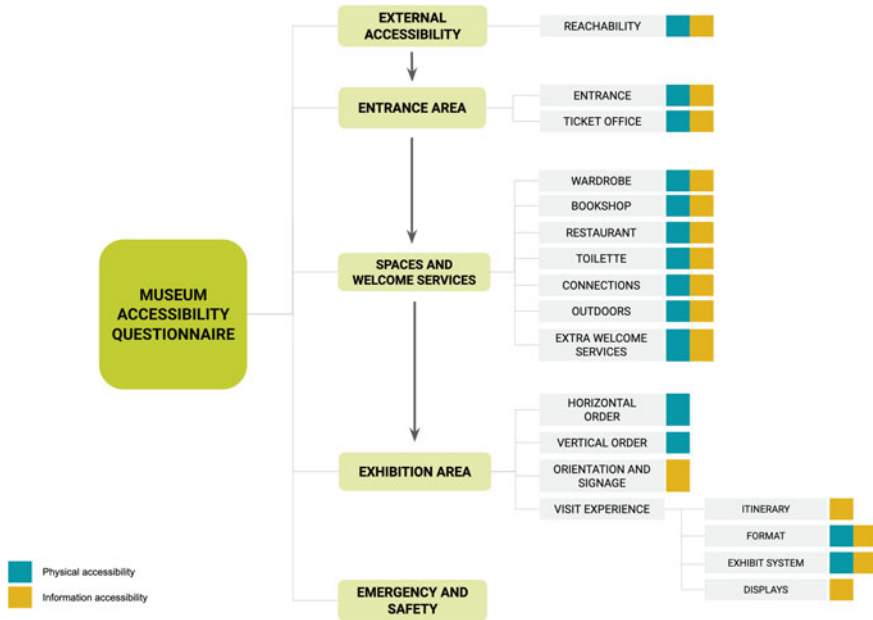
alternatives, YES/NO type. This combination makes it possible to obtain both quantitative and qualitative data, by which it will be possible to measure the level of accessibility of every museum area to which it is applied.

The second peculiarity of the questionnaire is that it is structured to be compiled by researchers/evaluators and professionals during inspection of museums and therefore blocks represent the museum spaces while the sequence corresponds to the itinerary inside spaces.

The sub-blocks (shown in grey in Fig. 8) will be used/not used depending on if that type of space or feature is present or not in museum to which they are applied.

Table 3, summarizes some of the most important tips identified in the literature and coming from Preece [11, p. 400], Guidicini [7, pp. 19–20] and Bradburn [1, pp. 283–285] that aim at a good questionnaire usability by the interviewees.





**Fig. 8** XAll questionnaire (developed by Serra and Nichilò for XAll project)

**Table 3** Instructions for structuring a questionnaire

*1—General structure*

- Give an appropriate order to the questions and number them because the impact of a question can be influenced by their order [11]
- Numbering questions can alert either the respondent or the interviewer that a question has been skipped and will suggest to respondents how long the task will take [1]
- Organize questionnaire in blocks of questions, each one oriented to develop a different topic [7]

*2—Question formulation*

- Make questions clear and specific; when possible, ask closed questions [11]
- Minimize number of questions that may encourage uncertain answers [7]

*3—Answers formulation*

- Find a formulation able to involve the respondents in each answer option/In order to obtain meaningful answers [7]
- “Consider including a “no-opinion” option/for questions that seek opinions” [11]; this helps not to create false results if the user does not recognize himself/herself with the given categories

*4—Evaluation scales*

- Make sure the range scale is appropriate, intuitive and does not overlap
- Use numbers consistent with the evaluation you are asked to express: for example, it is more intuitive in a scale of 1–5 for 1 to indicate low agreement and 5 to indicate high agreement [11]

(continued)

**Table 3** (continued)

<i>5—Language</i>
<ul style="list-style-type: none"> <li>• Use a language appropriate to the target group, as it favours a correct reading of contents [7]</li> </ul>
<i>6—Instructions</i>
<ul style="list-style-type: none"> <li>• Provide clear instructions on how to complete the questionnaire [11], put theme at the point where they will be used [1].</li> </ul>
<i>7—Layout</i>
<ul style="list-style-type: none"> <li>• Design a layout that help graphically to make the questionnaire clearer and more readable but keeping it as compact as possible [11]</li> <li>• Avoid split a question, including all its answer categories, between two pages or screens [1]</li> <li>• Avoid having two or more columns of questions or put two or more answer categories on the same line to make the questionnaire appear shorter because it interferes with standard reading patterns [1]</li> <li>• Use a typeface sufficiently large and clear as to cause no strain in rapid reading for all potential respondents [1]</li> </ul>

## 4 Conclusion

The results of research conducted by LED Laboratory—on numerous projects concerning: (a) product usability evaluations; (b) innovative and/or inclusive products/systems/services design; (c) product comparison; (d) drafting of guidelines—confirm that questionnaires are the most appropriate methodology for collecting user evaluation by means of quantifiable and comparable data.

The tool has also demonstrated to be functional to data integration when it is used to support other survey methodologies or in synergy with them.

The quality and relevance of the data obtained proved to be directly proportional to the correct design or the correct use of the questionnaire by the researcher/interviewer.

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# **Universal Design and Education**

# An Educational Path on Universal Design. Video Games as Learning Tools



Giorgio Buratti , Fiammetta Costa , and Michela Rossi 

**Abstract** PUDCAD (Practicing Universal Design Principles In Design Education Through A Cad-Based Game) is a project founded by the European Erasmus + program for innovation and sharing of good practices in education. It provides, at systemic level, the modernization and activation of educational paths through cooperation with partners from different countries through participatory approaches based on ICT. The aim of PUDCAD is the creation of a playful computer assisted drawing application that allows interior architecture and design students to learn and use Universal design principles. This paper explains the different stages of research implementation. The first step was a workshop focused on a survey method developed to verify the compliance of educational environments with the principles of Universal Design (Checklist). Together with simulated direct experience (Empathy trial), it led the students involved to the creation of scenarios for school integration. In the second workshop the application of ad hoc parameter of universal design for spaces of learning led to the definition of Game Maps, where environments and characters of the game were identified. In the third, building on the second step material, table games able of sensitizing the user and supporting her/him in the design of inclusive environments were developed. In the fourth workshop the students developed and tested the videogame's Alpha version providing feedback and ideas for the ultimate version presented in the fifth workshop. Reviewing the process applied to build the application, the article explores educational experimentation and pedagogical aspects, emphasizing how the videogame, beyond entertainment, can support and promote new learning paths complementary to canonical teaching methods.

**Keywords** Ergonomics · Universal design · Gamification · Inclusion · Participation · Design education

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