Journal of Universal Computer Science, vol. 25, no. 2 (2019), 122-153
submitted: 20/4/18, accepted: 26/2/19, appeared: 28/2/19 © *J.UCS*

Designing a Human Computation Framework to Enhance Citizen-Government Interaction[1]

Koldo Zabaleta
(Deusto Institute of Technology - DeustoTech, University of Deusto, Spain
koldo.zabaleta@deusto.es)

Unai Lopez-Novoa
(Data Innovation Research Institute, Cardiff University, United Kingdom
lopezu@cardiff.ac.uk)

Ivan Pretel
(Fon Labs, Spain
ivan.pretel@fon.com)

Diego López-de-Ipiña
(Deusto Institute of Technology - DeustoTech, University of Deusto, Spain
dipina@deusto.es)

Vincenzo Cartelli
(BEng Business Engineering, Catania, Italy
vincenzo.cartelli@gmail.com)

Giuseppe Di Modica
(BEng Business Engineering, Catania, Italy
giuseppe.dimodica@dieei.unict.it)

Orazio Tomarchio
(Dept. of Electrical, Electronic and Computer Engineering
University of Catania, Italy
orazio.tomarchio@dieei.unict.it)

Abstract: Human computation or Human-based computation (HBC) is a paradigm that considers the design and analysis of information processing systems in which humans participate as computational agents performing small tasks and being orchestrated by a computer system. In particular, humans perform small pieces of work and a computer system is in charge of orchestrating their results. In this work, we want to exploit this potential to improve the take-up of e-service usage by citizens interacting with governments. To that end, we propose Citizenpedia, a human computation framework aimed at fostering citizen's involvement in the public administration. Cit-

[1] This article is an extension of a conference paper: I. Pretel, U. Lopez-Novoa, E. Sanz-Yague, D. López-de-Ipiña, V. Cartelli, G. Di Modica and O. Tomarchio. Citizenpedia: A Human Computation Framework for the e-Government Domain. 14th IEEE International Conference on Ubiquitous Intelligence and Computing (UIC 2017)

izenpedia is presented as a web application with two main components: the Question Answering Engine, where citizens and civil servants can post and solve doubts about e-services and public administration, and the Collaborative Procedure Designer, where citizens can collaborate with civil servants in the definition and improvement of new administrative procedures and e-services. In this work, we present the design and prototype of Citizenpedia and two evaluation studies conducted: the first one, a set of on-line surveys about the component's design, and the second one, a face-to-face user evaluation of the prototype. These evaluations showed us that the participants of the tests found the platform attractive, and pointed out several improvement suggestions regarding user experience of e-services.

Key Words: Human computation; E-government; Human-computer interaction
Category: H.5, J.1

1 Introduction

Human computation or Human-based computation (HBC) is a field that considers the design and analysis of information processing systems in which humans participate as computational agents [Michelucci, 2013]. In particular, humans perform small tasks and a computer system is in charge of orchestrating their results. These tasks would require complex computer algorithms to be accomplished, but due to their nature they are easily completed by humans, e.g. to recognize an image or some distorted and blurred text [Von Ahn, 2005] [Quinn and Bederson, 2011].

In the private sector, human computation is used massively in different fields [Quinn and Bederson, 2014][Pe-Than et al., 2015]. For instance, Web 2.0 relies on users' contents as their core business, e.g. in web applications where the contents are almost solely provided by users, such as YouTube, Flickr or TripAdvisor. On the other hand, in the public sector, fields such as e-government or emergency response also benefit from human computation, e.g. in the policy making activity [Prpic et al., 2015] or in emergency management [McNutt, 2014].

However, the potential of human computation in the field of enhancing and streamlining e-service contents and workflows is not fully addressed in the literature. In an attempt to fill in this gap, we propose Citizenpedia[2], a tool aimed at fostering citizen's involvement with the Public Administration (PA), and sharing improvements on public resources in a semi-automatic basis. The main idea is to bring concepts and technology already used in private industry sectors to the PA, such as the idea of continuous improvement of processes and the exploitation of cognitive systems technologies.

The Citizenpedia is a web-based component that offers two main tools for citizens and civil servants: the Question Answering Engine, which enables the citizens to post and solve doubts around e-services and public administrative procedures, and the Collaborative Procedure Designer, which allows the civil servants to model public services and workflows, to then expose them to the citizens and gather their feedback.

In this paper, we present several stages in the development of a Citizenpedia prototype, and some lessons learnt from two distinct user-based evaluations. First, we describe its concept and design, and then an evaluation of this design, conducted as a set of on-line surveys which where filled in by 215 persons across three different countries. After that, we detail the software design and architecture of the Citizenpedia, and then the results of a user-based evaluation where 204 participants tested the platform. In this last trial, users found Citizenpedia attractive, but still moderately useful, and provided us with many improvement suggestions that will be used to further improve the usability and user experience of the provided component. Finally, we provide a link to the source code of Citizenpedia at the end of the manuscript for any researcher/collective willing to test it.

The remainder of this paper is structured as follows: we present in Section 2 an overview of the state of the art in human computation techniques, with focus on the e-government domain. Section 3 describes the overall concept and design of the Citizenpedia. Section 4 shows how we evaluated it through a set of on-line surveys. Section 5 describes the software architecture of the Citizenpedia. Section 6 describes the user-based evaluation we conducted, with an analysis of the results. Finally, we draw some conclusions and describe the next steps in Section 7.

2 Related Work

This section compiles some of the most relevant contributions in the field of human computation that have served as reference in the development of the Citizenpedia. We have divided the section in two groups: already existing platforms, such as online web platforms or mobile applications, and contributions found in the scientific literature.

2.1 Deployed services

The most popular human computation platform is Amazon Mechanical Turk [AmazonMechanicalTurk, 2018], which can be defined as a *Human Intelligence Task Engine*. It is a marketplace where users post jobs and offer money for getting them done. Waze is a popular GPS path-guiding application for smartphones and tablets. It calculates the path to be followed by a user driving a car, and shows alerts about traffic jams, accidents, etc... These alerts are introduced by other users in the system. In contrast to Mechanical Turk, the

[2] The Citizenpedia is a development part of the European H2020 SIMPATICO project. It has no relationship with the proposal presented by Thalos in [Thalos, 2015] also named *Citizenpedia*.

reward here is a better driving experience. Other less-known tools are MalariaSpot [Luengo-Oroz et al., 2012], GalaxyZoo [Lintott et al., 2008], and The Illustration Archive[Havery and Lloyd, 2016] online platforms that assign small processing tasks to humans giving reputation as reward.

Focusing on the area of PA and e-government, several approaches based on digital systems and services have been discussed for a more engaged consultation and participation [Torres et al., 2005]. Furthermore, one of the main addressed challenges is the enhancement of the public processes, which are complex and bureaucratic [Claver Cortés et al., 2015].

Among these approaches, mySociety e-democracy project. It offers many online democracy tools for citizens. These tools are released as open source projects, and many councils in the UK have adopted them to ease the burden between citizens and administrations. We want to highlight two of them: FixMyStreet[Walravens, 2013], a map of the city where citizens can comment on roads or paths that need mending, and WhatDoTheyKnow[Parsons, 2017], a public question & answer portal, where citizens post questions and requests to the local administrations. Another tool tackling e-government and e-democracy issues is LiquidFeedback [De Cindio and Stortone, 2013], an open source web platform for proposition development and decision making.

2.2 Scientific contributions

Previous works have explored what are the key factors that lead to better acceptance of e-government portals and services. For example, [Yap et al., 2017], carried out a study among 123 Malasyan elderly people who had, at least, secondary studies. The conclusion of this study was that users (in this case elderly) find e-services acceptable, being "perceived value" and "social influence" core factors to widen their adoption. SIMPATICO considers that a wider acceptance of e-services is only possible is they are further democratized, i.e. simplifying e-services' consumption. Citizenpedia, the component described in this paper, tackles the challenge of offering continuous in place support to users whilst consuming e-services in the form of administrative procedure graphical views and associated questions and answers.

On the other hand, [Androutsopoulou et al., 2018] introduces a platform which enables richer and more expressive interaction of citizens with government in everyday language, through chatbots, facilitating and advancing both information seeking and conducting of transactions. A similar approach is followed in SIMPATICO, since user interactions with e-services are also mediated by automatic text simplification and workflow adaptation computing methods. A remarkable difference, is that SIMPATICO adopts a hybrid intelligencde approach thanks to Citizenpedia, since it combines machine (algorithms) and human driven intelligence to simplify e-services.

In [Charalabidis et al., 2012] authors propose a methodology that would enable public administrations to get more out of the comments that citizens post in social networks for policy making. This methodology is composed by four phases in a cycle (Listen, Analyze, Act and Receive), and for each phase the technologies that should be used are described. For example, authors suggest using crawlers for the "Listen" phase in order to capture information and Natural Language Processing tools for the "Analyze" phase. The paper provides deep description on the methodology, but no results that could evaluate the effectiveness of the contribution.

The work on the previous paper was extended in [Charalabidis et al., 2014] where authors present the next step over the methodology: the functional architecture of an ICT platform supporting the methodology, with some details on its technological constraints. They describe how their design was driven by several use cases in Austria, Greece and the UK, and the steps they followed.

In [Asquer, 2014] the author presents a survey paper about gamification applied to public services and provides a discussion on the topic. This discussion traverses some fields related to public services, such as education, and how the gamification would impact in them. This contribution is a good starting point to dive into the scientific literature on the topic, but staying on the theoretical concepts.

In contrast, the paper presented in [Bista et al., 2014] describes a practical experience on the topic: authors describe their work in introducing gamification in a online service of the Department of Human Services of the Australian Government. They provide a deep description of every phase they conducted: their motivation, the design of an ad-hoc gamification model, its implementation (including technical detail, such as its deployment), and an analysis of the usage that the online service had. The paper provides extensive descriptions on their experience, and several guidelines for the ones that follow their steps.

Finally, some works [Dargan and Evequoz, 2015][Engiel et al., 2014] try to promote the use of Business Process Management (BPM) practices in the public administration to improve the quality of e-services. Specifically, the platform in [Dargan and Evequoz, 2015] is created using the concepts of user-centered design and gamification design methodologies. Authors take the scenario of the administration of Switzerland, in particular in the Swiss Process Sharing platform, but do not put it into implementation. They use it to analyse the requirements and potential pitfalls. In [Engiel et al., 2014] instead, process models are used as a mean to promote transparency and communication between public organizations and citizens: it also proposes a way to design public services process models aiming at increasing their understandability.

3 The Citizenpedia approach

The Citizenpedia component aims to complement e-government environments with a collaborative space where citizens and civil servants can share knowledge, and more specifically, a collaborative space where citizens can solve their doubts and actively take part in the enhancement and better understanding of e-services. To that end, we have designed the Citizenpedia, a participation (one of the key pillars of Open Government) fostering component, with two complementary tools, which are described next.

3.1 Question Answering Engine

The Question Answering Engine (QAE) is a tool which provides a mechanism where citizens post and resolve doubts regarding e-services and public administrative procedures. The chosen look-and-feel for this tool is similar to popular question & answer tools.

The main functionality of QAE is to create and answer questions in a public manner. Users are encouraged to contribute contents in a public manner, with the aim for all the generated information to remain over the time. This is usual in QAE places in the field of engineering (e.g. Stack Overflow), where sometimes an answer written two or three years past in time is useful for the user looking for a doubt. In addition, questions are searchable and sortable.

The QAE design considers to have two main usage roles: user and moderator. Initially, every citizen is a user and every civil servant is a moderator. Users can search along Citizenpedia and post content. Moderators have higher privileges, i.e., permission to edit/delete contents from other users, addressing the problem of low quality or even offensive contents. In order to keep the user engaged, a rewarding and reputation mechanism is considered. Each time a user conducts an action (e.g. posting/answering a question, leaving a comment,...), it is recorded and several points are given. Upon certain amount of points, badges are given. This enables users to gain reputation and distinguish most active participants in the community. In addition, we consider that once a user reaches certain level of reputation, he/she gains rights.

3.2 Collaborative Procedure Designer

The Collaborative Procedure Designer (CPD) is a tool to describe current administrative procedures in the form of flowcharts/diagrams, that enables citizens to comment on them. The core of the CPD is a model that allows the definition of multiple hierarchical views, each providing a representation of the procedure with a growing level of detail.

Currently, the CPD shows two low-hierarchical views: the *value-chain* view and the *interaction* view. The *value-chain* provides information concerning the sequential phases that a given administrative procedure is broken into. If an e-service needs to be used in a procedure phase, information about it is also given. From this view, it is possible to learn the name of the phases and realize the phases' temporal order. By expanding a specific phase, an *interaction* view gets displayed. This view shows a flow of the interactions between the citizen and the PA that are carried out in that phase. For any interaction, it is pointed out who of the two actor types is the interaction's initiator. Also, the communication channel through which the interaction will occur is explicitly indicated by means of specific icons.

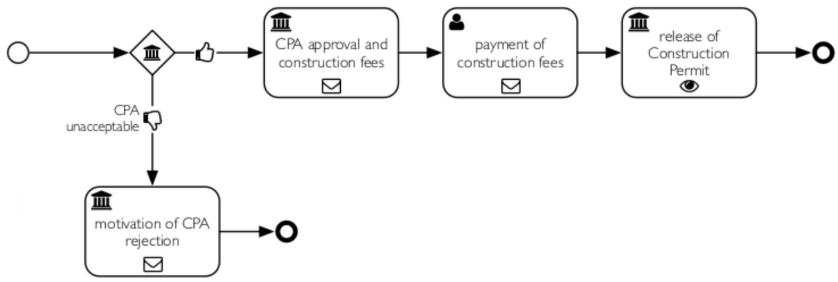

Figure 1: Example of administrative procedure diagram

The example shown in Figure 1 provides an expanded view of the phase named "Proceedings for the Release of Construction Permit" that belongs to the "Construction Permit" procedure diagram. In the future, it has been planned to add another view to the two mentioned: the *business process* view. That view, which will be realized by means of standard notations like the BPM and Notation (BPMN), is meant to represent the workflow of PA activities going on behind the scenes to serve the citizens' needs.

While the citizen is the user that will benefit of these views, the civil servant is in charge of drawing the views. In fact, the latter is provided with a graphical designer and a set of drawing tools that they can use to easily create the hierarchical views of an administrative procedure. In the role of citizen, the user is also allowed to interact with the diagram by asking specific questions whenever there is unclear information or further descriptions are needed. The role in charge of responding to the citizen is the civil servant. Both the citizen's questions and the civil servant's responses are not directly handled by the CPD but, instead, are handed over to the QAE; thus complementing the CPD workflow modeling capability with the collaborative dynamic FAQ behaviour added by the QAE.

The final objective of the CPD is to implement a collaborative environment on which the stakeholders (citizens and civil servants) cooperate to the design and the improvement of administrative procedures. In order to stimulate such participation and cooperation, the CPD adopts the same rewarding and reputation mechanism designed for the QAE.

3.3 Framework

Even though the QAE and CPD have been described as tools with a different set of functionalities, both are contained within Citizenpedia and are seamlessly integrated, since they complement each other. The main link between them is the concept of administrative procedure and the questions around them. QAE and CPD share a common data model and, consequently, an underlying database of information. Thus, a person viewing the diagram of a procedure can see the questions for a certain step, and with two clicks jump to the QAE, in order to get more answers and more detail about that question.

Within this framework, we assume that a significant portion of the information in Citizenpedia will be generated by users, e.g. the answers to the questions, and this poses several challenges. For example, users giving incomplete or incorrect answers, users adding spam into the replies or outdated answers due to updates in the steps/requirements of an administrative procedure. In order to mitigate these issues, we add the figure of moderator among the user roles, who will take care of the quality of the contents. The same figure is used in popular crowdsourcing sites such as Wikipedia. Besides, an spam detector has been added to the QAE so that offensive language is detected before a new question or answer post is submitted.

In the current design, we consider that some civil servants from the public administration hosting Citizenpedia (e.g. city or region council) should have the role of moderator. These people will be in charge of reviewing and rating answers, deleting improper content and adding information to the platform that will be helpful for the users. This latter point is very relevant, since in order to kick start the usage of a service such as Citizenpedia, initial high value contents have to be added by the civil servants themselves, e.g. some candidate good questions and answers and elaborated work flow diagrams of the administrative procedures modeled. Hence, civil servants could enter into a conversation through Citizenpedia with the users to solve doubts more accurately.

4 User-driven Design Evaluation

Prior to the implementation of the Citizenpedia, we conducted an evaluation of its design. The goal was to validate our design decisions, and to gather the impressions from the potential users. This section details, first, how we prepared the evaluation and then, summarizes the results obtained.

4.1 Evaluation setup

One of the aims of this evaluation was to reach the largest number of surveyed persons in a effective way. Thus, we discarded approaches like group meetings or interviews, and decided to conduct personal online surveys. This way, the distribution of the surveys would be instant (just by sharing the URL to the proper collective) and we could give enough time for the users to fill in the forms.

The online survey was created using Google Forms and it was divided in two parts, each containing a mock-up video illustrating functional aspects of the Citizenpedia and some questions that the users had to answer. These questions were ad-hoc developed to infer the discretionary usage of several e-government interaction methods. The first part of the survey was focused on the Question Answering Engine (QAE) and also in some general aspects of the Citizenpedia. The second part was related to the Collaborative Procedure Designer (CPD), and the video and questions were different depending on the user type filling the survey (citizen or civil servant). The survey ended with some common demographic questions (e.g. gender, age,...) in order to be able to cluster answers according to sociodemographic criteria. Given the heterogeneity of the e-services used by the European Public Administrations, the questionnaires were distributed among citizens and civil servants of three representative European Contexts: Sheffield (England) as university city, Galicia (Spain) as a large territory and Trento (Italy) as a modern-service city. Sheffield has seen an increase in the number of overseas students and in economic migrants from within the European Union. Trento is already among the top smart-cities with a modern service sector and a high quality of life. Galicia is a large territory administered by a regional-level government agency with a large degree of self-government. We created a survey per target region in each local language, i.e., English, Spanish and Italian. In all cases, the same question/answer set was provided, translated to the corresponding language. Notably, the regions where the survey was distributed correspond to the pilots of the SIMPATICO project and were open for one month (June 2016).

4.2 Results

Once the surveys were closed, we proceeded to the collection of the results and to their analysis. In this section, we provide a summary of the results, described following the order of the questions in the surveys. Even though the surveys were

Table 1: Number of participants of the surveys by country and role

	England	Italy	Spain	*Total*
Citizens	5	34	113	152
Civil Servants	0	15	48	63

conducted in three languages, we describe all the results in English for the sake of clarity.

Table 1 shows the number of participants by country and role. After analysing the citizens' results, we noticed a bias produced by age instead of country (given the significant imbalance of answers per country, e.g. observe the England case). Thus, we grouped the citizens' answers by the age range criteria in order to extract meaningful conclusions. The resulting groups are reported in Table 2. In contrast, the answers for the civil servants were analyzed separately, as most of them were middle-aged. We will describe the answers of the civil servants at the end of this section.

Table 2: Grouping of the citizen participants for analytical purposes

Group name	Age range (years)	Sample size
Youngsters	18-34	42
Middle Age	35-64	55
Elderly	65+	55

Initially, the survey showed to the participant a mock-up video of how a citizen solved a doubt using the QAE[MORElab Research Group, 2016c]. After that, the first question aimed to measure discretionary use of Citizenpedia. As Table 3 exposes, the Citizenpedia platform would be a widely adopted solution to clarify issues related to procedures of public administration. The adoption level is directly associated to the age: the younger is the citizen, the higher is the solution's adoption. Several comments were gathered after this question and they were taken into account during the requirements elicitation.

Another interesting finding on the results was the high usage of Q&A platforms, discovered through the answers to the question reported in Table 4. More than 55% of users of all ages reported to have previously used a Q&A engine to ask/post doubts. This finding is relevant, as a significant portion of the surveyed users find the Citizenpedia familiar. However, we also found that a very small percentage of people devoted time to answering questions in these portals. Therefore, it is obvious that it is critical to promote a more "prosumer"

Table 3: Answers to: *If you had access to such web portal to clarify e-service issues, would you use it?*

Youngsters	**Middle Age**	**Elderly**	**Response**
76.19 %	76.36 %	54.55 %	Yes, as a first choice
19.05 %	14.55 %	32.73%	Just when I am not able to go physically to the public administration
2.38 %	5.45 %	9.09 %	I don't think so
2.38 %	3.64 %	3.64 %	Other

behaviour of users using such type of collaborative solutions.

Table 4: Answers to: *Have you ever used a question-answering portal?*

Youngsters	**Middle Age**	**Elderly**	**Response**
21.43 %	23.63 %	16.36 %	Yes, both to post and answer questions
47.62 %	49.09 %	40.00 %	Yes, to ask questions / post doubts
7.14 %	3.64 %	1.82 %	Yes, to answer other's questions
21.43 %	20.00 %	41.82 %	No, I've never used one
2.38 %	3.64 %	0.00 %	Other

Then, we asked the participants whether they found attractive gaining points as reward for answering questions. This is implemented in some Q&A portals where the more points gained, the more reputation you obtain in the portal. When a user reaches certain level of reputation, he gains permission to moderate or manage the portal. According to Table 5, the youngest group could be persuaded by using a virtual rewarding system as well as reputation. This last term, reputation, is not an effective motivation to enhance the participation of the rest of groups. However, according to several comments of the surveys' participants, it is an important aspect to consider, since making explicit those answers given by users of higher reputation, usually implies better reliability and quality on the portal. We found this comment by a participant relevant: *For me, a high reputation of the answers owner means high quality of the answers.*

Regarding the problems which citizens experienced during public administration procedures, Table 6 exposes that the most common ones are related to the complexity of the documents and procedures. Despite of the fact that the three groups provided similar results, the youngest group had significantly more problems interpreting the guidelines terms, which is a surprising result given that youngsters should have had access to better education, although perhaps

Table 5: Answers to: *In some question&answer portals users gain points as reward for answering questions. The more points gained, the more reputation in the portal. When a user reaches certain level of reputation, he gains permission to moderate and manage the portal. Do you see it as an attractive feature?*

Youngsters	**Middle Age**	**Elderly**	**Response**
50.00 %	29.09 %	27.27 %	Yes, it would encourage me to participate more actively in Citizenpedia
42.86 %	29.09 %	21.82 %	Yes, but I don't think that it would make me be more active
4.76 %	40.00 %	47.28 %	No
2.38 %	1.82 %	3.64 %	Other

they have less experience carrying out administrative procedures. Furthermore, the structure of the information gathering/completion process (e-service) and usability are other common difficulties identified by participants comments. For example: *I don't know which one is the correct web page*, *I am always lost browsing e-services of the public administration...* Consequently, Citizenpedia should satisfy not only the need of having a friendly description of procedures and terms, but also the need of an easy-to-use site.

Table 6: Answers to: *Think of your previous experiences with public administration. What kind of time-costly problems have you experienced?*

Youngsters	**Middle Age**	**Elderly**	**Response**
69.05 %	49.09 %	43.64 %	The guidelines contained many hard terms to understand
52.38 %	49.09 %	49.09 %	The guidelines were too long
45.24 %	21.82 %	16.36 %	I was not sure if I was eligible (if the administrative process was applicable to me)
35.71 %	27.27 %	10.91 %	The required documents (passport, driving license, ...) were not clearly stated
4.76 %	14.55 %	9.09 %	Other

The most used channel to solve the most common problems depends on the age (see Table 7). Firstly, youngsters look up for a solution on the Internet as a main choice. The middle age group adds contacting with civil servants to the Internet browsing. Finally, the oldest group presents, as a main choice, a combination of asking a relative or a friend and Internet: asking somebody to find a solution through Internet because their smaller acquaintance and experience with digital technologies.

Table 7: Answers to: *When suffering from any of the previous problems, where did you find help?*

Youngsters	**Middle Age**	**Elderly**	**Response**
45.24 %	34.55 %	40.21 %	I asked a relative/friend
40.48 %	41.82 %	30.91 %	I contacted with civil servants
69.05 %	41.79 %	45.45 %	I looked up for a solution on the Internet

In this last question (Table 7), we asked the participants who checked *I contacted with civil servants* option, to indicate which channel they used to do so. The results of this additional questions are shown in Table 8: the most used channels are telephone and physically attending to the PA premises. Moreover, a clear pattern can be seen: the younger age range the citizen belongs to the more digital the chosen channel is.

Table 8: Preferred channel to contact a civil servant, from the answer *I contacted with civil servants* to the question *When suffering from any of the previous problems, where did you find help*

Youngsters	**Middle Age**	**Elderly**	**Response**
26.68 %	31.52 %	56.30 %	Going to the PA buildings
40.05 %	31.64 %	25.02 %	Telephone
6.67 %	5.27 %	6.16%	Internet
26.60 %	31.58 %	12.53 %	Other channel

From here on, the second part of the survey is described. This part, related to the Collaborative Procedure Designer, was different depending on the type of users taking the survey. We will focus, first, on citizens: these participants viewed first a mock-up video with a citizen leaving a suggestion on a bureaucratic procedure using the CPD[MORElab Research Group, 2016a]. After that, we asked whether the concept was clear to the participants or not.

Results about the level of understanding achieved by citizens regarding the CPD are shown in Table 9. Overall, younger citizens were the ones that better understood the concept. In contrast, close to 40% of the elderly participants did not fully understand the steps of a flowchart.

In the case of civil servants, the mock-up video showed how a civil servant revised the comment left by a citizen in the CPD[MORElab Research Group, 2016b].

Table 9: Answers to: *In the flowchart, are you able to distinguish the internal procedure from the interactions with the citizen?*

Youngsters	Middle Age	Elderly	Response
90.48 %	76.36 %	61.82 %	Yes, I understand who does each of the steps
9.52 %	23.64 %	38.18 %	No, I don't have a clue

After that, we asked the participants to empathize with the citizens, and to think what would be the best channel to communicate feedback to the public administration.

Results for this question are shown in Table 10. In order to suggest enhancements, the favourite channel does not depend on the age . The favourite one is leaving comments in the flowchart. Sending e-mails and posting questions are also frequent choices.

Table 10: Answers to: *Imagine you were a citizen: you find something that should be improved or modified in the flowchart of a procedure. What would you do?*

Youngsters	Middle Age	Elderly	Response
73.81 %	60.00 %	43.64 %	Leave a comment in the flowchart
26.19 %	25.45 %	34.55 %	Post a related question in the Q&A portal of Citizenpedia
23.81 %	27.27 %	25.45 %	Send a message/e-mail to the civil servant who created it

The final part of the questionnaire included a free-text field where the users could leave their comments and impressions. From the citizens' comments gathered, it can be stated that the elderly group's view should be further taken into account in order to enhance usability and the simplicity of the PA content as source is critical, i.e. despite the technological support that you may offer to ease e-service completion, it is first essential to ensure that the provided contents are as simple as possible. Furthermore, smartphones should be considered as an important interaction channel to perform tasks associated to interacting with public administration. As a result, we should take into consideration the limitations of these devices.

In contrast, civil servants' feedback poses a different point of view: most of their comments relate to how the systems should be, with their stakeholders in mind. In particular, most the comments where gathered from civil servants in the Galicia region, where elderlies represent a significant part of the people interacting with PA. We drew two main conclusions from their comments: first, the system should be simple and it should use symbols/pictures easy to recognize. We want to highlight a suggestion by a civil servant, who encouraged us to follow the already existing notation in physical public administrations due to its ease of recognition. The second conclusion, beyond the IT tasks, is that we should invest time and effort training citizens, especially the elders, to bring them closer to new technologies, in this case Citizenpedia.

5 The Citizenpedia component architecture

Having gathered the user's feedback from the surveys, we designed the software architecture for the Citizenpedia. In this section, we describe the different software components that form the devised participatory tool block by block. Some of the components are required by the QAE and the CPD to work, but they are not directly exposed to the user. The overall architecture is depicted in Figure 2.

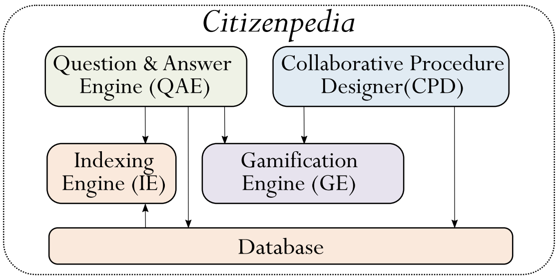

Figure 2: Citizenpedia software architecture

The first component in the figure represents the QAE, whose functionality has been described in Section 3.1. Driven from the user evaluation explained in the previous section, a simple user interface and responsive web interface was conceived. Several participants of the surveys, especially elderly ones, reported to consider Citizenpedia a good idea but only if it was intuitive to use. On the software side, we constructed the QAE based on the already existing PaizaQA [PaizaQA, 2016]. We provide a screenshot in Figure 3, showing an example question with an answer in a PC web browser.

Along with the QAE, the CPD is the other component that exposes functionality as described in Section 3.2. The same as with the QAE, a responsive and easy to use web interface was implemented, a screenshot is shown in Figure 5 taken in a PC web browser. It shows the *value-chain* view with the different steps for the example "Wellness programs in spas" administrative procedure. On the

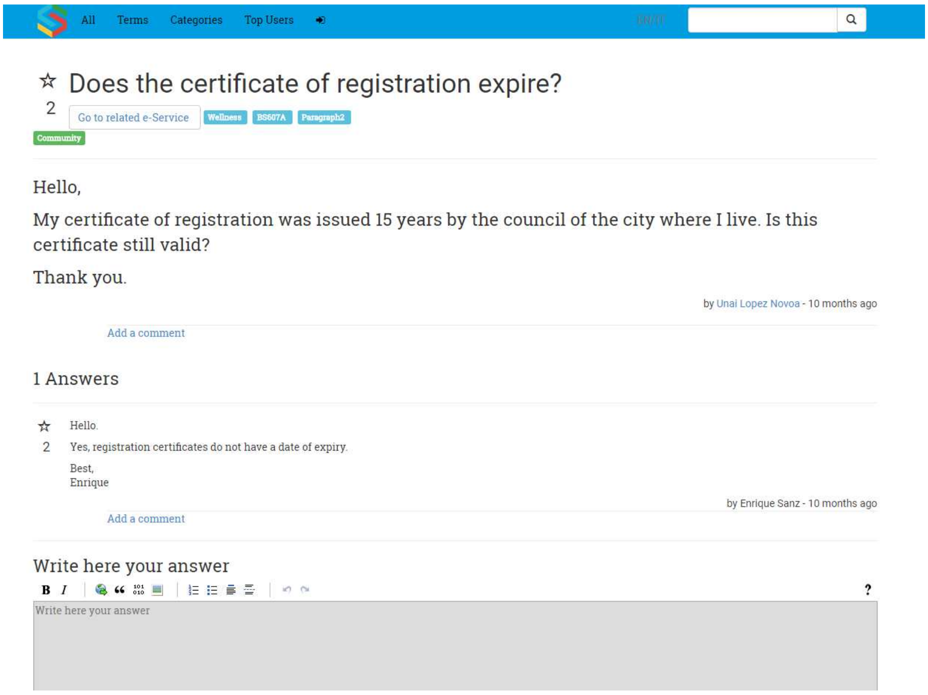

Figure 3: Screenshot of QAE with a sample question

software, the CPD is composed of a server side that uses the Vert.x framework, and a client side developed as an Angular2 web application.

As a common substrate for the QAE and CPD, we have deployed a database and an indexing engine grounded on the administrative procedural model devised by SIMPATICO. This model in shown at Figure 4, where the relationship between the different entities assembling an administrative procedure are shown. Notably, Citizenpedia contributes with the Annotation Elements that enrich e-services composing an administrative procedure. The database contains all the information for the Citizenpedia, and in the current version MongoDB is used. The indexing engine is in charge of improving the text-based queries in the QAE, e.g. by handling misspelled words (typos) which has been deployed with the help of ElasticSearch engine.

The final piece is the gamification engine, which complements the other blocks of Citizenpedia. Each time a user performs an action, e.g. answering a question, it is registered in the gamification engine, and its reputation skill is computed. In the presented prototype, the SmartCampus gamification engine is used [Smart Community Lab, 2018].

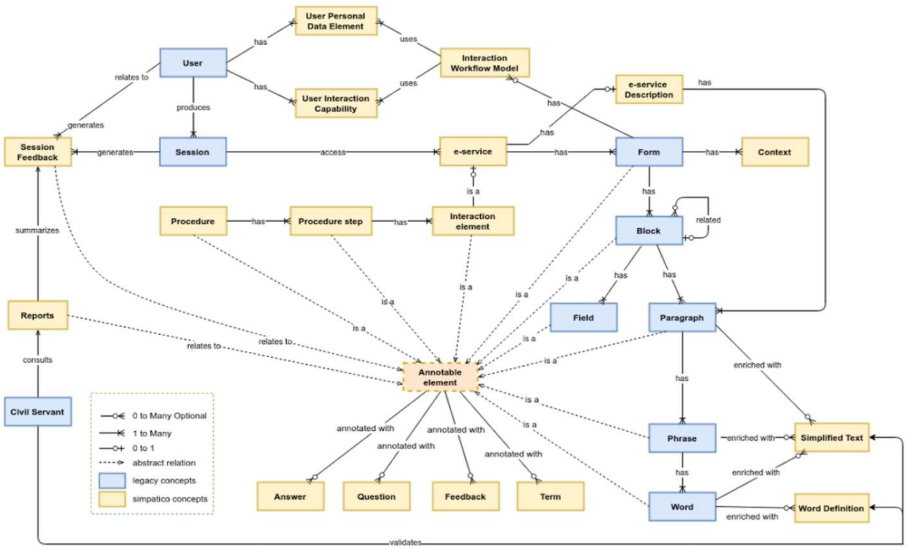

Figure 4: Administrative Interaction Model in SIMPATICO

Figure 5: Screenshot of CPD

6 Prototype Evaluation

Once a first prototype was built, we conducted a post-implementation user-based evaluation with the aim of getting more feedback from the community. This section explains the experimental setup and describes the results we obtained, for both tools composing the Citizenpedia component, namely QAE and CPD.The evaluation was conducted in two iterations, a first one mainly focused on the QAE, and a second one were the CPD was assessed. The main reason behind having two iterations was a set of technical difficulties that made impossible the deployment of the CPD in the first one.

The evaluation of the Citizenpedia platform was conducted as a part of a larger test for the SIMPATICO project, which aims to develop a set of tools and methodologies to ease the way that citizens of all kinds use electronic services provided by public administrations. The goal of these tests is to validate the developments of the project as a whole, but in this paper we will focus in the results for the Citizenpedia.

In the scope of Citizenpedia, the test had two main targets: the first one is to validate the technical decisions taken during development time. This includes validating the software developments that have been conducted from the point of view of stability and usability. The second one is to validate the design decisions taken after the results of surveys described in Section 4. In a nutshell, we wanted to check if we had correctly interpreted the needs expressed by the citizens.

Both iterations of the evaluation took place in the region of Galicia, Spain. Xunta, the local government, is a partner of the SIMPATICO project and provided three electronic services to be used as use cases for the evaluation. These services were selected because they have been running for at least a decade, they receive several hundreds of requests per year and they fit into the profiles and aims of the SIMPATICO project. The e-services are:

- BS607A [Xunta de Galicia, 2018a]: allows citizens to request financial aids to book stays in wellness centers, such as spas. This service is mainly targeted at the older segment of the population.
- BS613B [Xunta de Galicia, 2018b]: enables citizens to request financial support to acquire goods and services that enable personal autonomy. It is mainly targeted at citizens with some type of disability or functional diversity.
- BS611A [Xunta de Galicia, 2019]: enables the recognition of the degree of disability that a given citizen certifies. Associated to this recognition are different financial aids that Xunta provides to those citizens.

Services BS607A and BS613B were used in the first iteration (QAE assessment) and service BS611A was used in the second iteration (CPD assessment).

6.1 QAE assessment

Firstly, the QAE tool within Citizenpedia was evaluated according to the evaluation setup and results analysis outlined int the following sub-sections.

6.1.1 Evaluation setup

The tests focused on the QAE tool were conducted in October and November of 2017 in different facilities of entities that work closely with the Xunta, all of them in the region of Galicia, Spain. There were a total of 204 participants with the following profiles:

– 123 elderly citizens: retired people, at least 65 years old, with low to medium IT skills, e.g., able to use instant messaging in their smartphones or web browsing in a desktop PC by themselves, and able to use on-line banking or shopping on-line with the support of some else. These participants used the BS607A e-service as a use case.

– 65 citizens with some kind of disability: people at least 18 years old, with medium to high IT skills, e.g. able to do on-line banking or shopping on-line by themselves. These participants used the BS613B e-service as a use case.

– 16 civil servants from Xunta: 8 of them acted as participant using the BS607A e-service as a test case, and the remaining 8 did the same with the BS613B service.

During the evaluation we arranged the participants in groups of 10 to 30 and conducted several sessions that followed this structure:

1. Introduction to the session (~5 minutes): A facilitator of the session presented the motivation, aims and scope of the project and the test. To that end, the facilitator used a slides presentation.

2. Warm-up tasks (~15 minutes): Participants were asked to fill in an initial survey with demographic questions, such as their age, IT skills, etc. The remainder of the time was left for the participants to open and browse the e-service used as test case.

3. Training on the SIMPATICO tools (~25 minutes): A facilitator of the session presented the different tools developed as part of the SIMPATICO project, including the Citizenpedia, focusing on the QAE. The facilitator used a slides presentation and in the same time, the participants had access to an on-line web page with text descriptions, along with the e-service and the tools.

4. Fulfill the e-service using SIMPATICO tools (~15 minutes): Participants were asked to fulfill the use case electronic procedure, being the aim to submit a request for the offered service. They were encouraged to use the SIMPATICO tools in order to support in the process, e.g. read and post questions in the Citizenpedia's QAE. Made-up representative data was provided to the participants, so they did not have to use their personal information.

5. Ending survey (~10 minutes): Participants were asked to complete a survey with questions about their experience using the tools.

We want to detail that out of the 123 elderly participants, 68 of them did the test using an e-learning platform from their homes instead of attending to a face-to-face session. In these cases, the structure of the test was the same, but videos with the presentations of the facilitator were provided. Several technicians were available on-line in e-learning platform in order to answer the questions of the participants.

Given that the tests required the users to fulfill on-line forms and submit requests for financial support, we replicated the look-and-feel and the behaviour of the e-services. This way, the participants conducted the tests in a realistic manner, and the official database from Xunta was not modified. The look-alike of these e-services was validated by civil servants from Xunta, stating that they noticed no difference in its use compared to the real ones.

In this evaluation session, we populated Citizenpedia's QAE with several questions coming from the Frequently Asked Questions web page of Xunta de Galicia, which contained questions as *Where should I upload the documents for my application?* or *Can I verify that a submission has been completed successfully?*, and their corresponding answers.

Apart from the structure of the session, we established two ways of collecting information and feedback from the participants:

1. The surveys described as part of the second and fifth step of the evaluation session. These were created with Google Forms and followed the style of the ones used to evaluate the design of the Citizenpedia's QAE, as described in Section 4.

2. We instrumented the replicated e-services and Citizenpedia's QAE. We captured and logged different actions of the users, such as reading or posting a question in the QAE. This logging system was based on ElasticSearch, which allowed us to easily retrieve and analyse the data.

6.1.2 Results

Once the evaluation sessions concluded, we proceeded to collect and analyse the data. Our first effort was on the actions we recorded with the logging systems. The results for this analysis are shown in Table 11, which shows a list of the recorded events, its description and the number of users that triggered them.

The third, fourth and fifth columns of the table shows the number of different users that triggered an event, and not the total number of times that it was registered. We provide this metric, as we want to study the number of participants that achieved to trigger an action, no matter the amount of times. In addition, we were not able to distinguish between certain deliberate actions and automated ones, such as deliberate reload of the main page of the Citizenpedia and an automated one by the browser due to a timeout.

From the results of the log analysis, we see that just a small portion of the participants used the Citizenpedia's QAE. Roughly, half of the participants

Table 11: Number of participants that triggered the logged actions in the tests

Event	**Description**	**# in BS607A**	**# in BS613B**	**Total**
ctz_content_request (from e-service)	Load the Citizenpedia main page	16	32	48
ctz_question_request (from e-service)	Read a question from the QAE	4	8	12
ctz_new_question (from e-service)	Post a new question in the QAE originated in the e-service page	2	9	11
# of participants (Citizens + C. Servants)	–	131 (123 + 8)	73 (65 + 8)	204

that used the BS613B service opened the QAE's main page, but just 9 of them read/posted a question. This number is lower for the participants of the BS607A. We assume that the participants using the BS613B service were more attracted to use the QAE due to their overall higher IT skills.

Table 12: Number of triggered actions per e-service and paragraph

	BS607A		**BS613B**	
	ctz_question _request	**ctz_new _question**	**ctz_question _request**	**ctz_new _question**
1st paragraph	3	2	7	6
2nd paragraph	1	1	2	2
Other paragraphs	4	4	2	5
Total	8	7	11	13

In addition, we analysed the paragraphs that triggered each of the events. Each time a question is created, the QAE offers the posiblity to pin it to a certain e-service and paragraph from the text description. The aim is to provide to the civil servants a way to find the pieces of text that are most complicated and that should be rewritten. We registered this information during the tests and it has been summarised in Table 12.

As can be seen in the Table 12, results from the two e-services differ. We can see that questions read and posted for BS607A refer to different paragraphs of the e-service in a balanced manner. In contrast, the first paragraph seemed to attract most of the questions for BS613B. During our tests, we were not able to check if this paragraph suffered from real complexities that made its understanding difficult, or whether the participants used the first paragraph just to test the functionalities of our platform.

From these results, we must note also the low number of created questions. During the tests, all of participants accessed the same QAE instance, in order to foster the interaction and the communication via questions-answers between them. However, we are aware that this way of deployment might have affected negatively to the number of created questions.

After analysing the logs, we analysed the feedback from the final surveys that the participants fulfilled. The form had many questions related to the project and the different tools, but in this paper we are going to focus on the question related to the QAE tool within Citizenpedia: *Have you found the Question Answering Engine feature useful?*.

Table 13: Answers to *Have you found the Question Answering Engine feature useful?*

BS607A		**BS613B**		
Citizens	**C. Servants**	**Citizens**	**C. Servants**	**Answer**
16.9 %	40.0 %	21.0 %	20.0 %	Extremely useful
26.1 %	20.0 %	19.2 %	60.0 %	Very useful
21.5 %	10.0 %	22.8 %	20.0 %	Moderately useful
15.3 %	10.0 %	19.2 %	0.0 %	Slightly useful
20.0 %	20.0 %	17.5 %	0.0 %	Not useful at all
65	8	57	6	*Participants who filled the survey*

Table 13 shows the percentage of usefulness that the different groups of users perceived for the QAE. We must first note that 53% of the participants filled the final survey, and that most citizens performing the evaluation with BS607A service did not contribute to this final step. Looking at the numbers, we see how both groups of citizens left mixed feedback about the usefulness of the QAE. In contrast, civil servants using both test services found the QAE useful.

In order to further assess the feedback from the participants, we analysed the final item of the surveys: a free-text cell where the participants could provide any additional feedback. From the citizen participants, we received 51 comments and out of all them, 14 were positive, 10 were negative, 15 were improvement suggestions and 12 were general comments. We provide below the 4 most significant improvement suggestions we received, translated from Galician/Spanish as faithfully as possible:

– Although is true that the platform takes into account the accessibility problems that users could have, needs to be completely accessible for partially or totally blind people.

- The application is very interesting but it should be a little bit simpler and more intuitive.
- Maybe for people used to use these type of platforms is easy to use it but for someone like me is difficult to take advantage of all the possibilities it offers.
- A very interesting proposal but there is still a lot of work to do on the functionalities it offers.

On the other hand, we received 4 comments from the surveys that the 14 civil servants filled in. 1 of them is positive with no improvement suggestion and the other 3 include improvement suggestions. We provide here two of the suggestions, also translated from Galician/Spanish:

- Some of the survey questions are confusing because they have been written in a negative way.
- Must be clear who are the final users of this platform.

As an additional activity to the evaluation sessions, we conducted a focus group-like workshop with several members from Xunta, which were not involved as participants in the tests. In this focus group, we wanted civil servants to assess both Citizenpedia tools, namely QAE and CPD. We showed them the ideas and concepts behind the developments in SIMPATICO, and also the structure and preliminary results of the evaluation session. Overall, the feedback we gathered from this workshop was positive, and we also received some suggestions of improvement for the Citizenpedia. We provide the comments refering to Citizenpedia translated from Galician/Spanish:

- The CPD user interface is not self explanatory and users have problems to understand what can be done with it. Participants could have problems to find the icon which permits the access to the CPD from the QAE.
- Citizenpedia cannot present information generated by any citizen under the general umbrella of the e-service without stating that this could potentially be wrong. Moderation of the questions/answers should be added to the platform.

As an overall conclusion from the first evaluation of Citizenpedia with users, focused on the QAE, we can state that there is plenty of room for improvement in order to make it more appealing for the users. Civil servants have found the tool promising, but we need further development in software features to ensure that it becomes a useful tool for the citizens. Special attention should be paid to the design of the user interface, for the elderly persons to find it attractive and amenable.

6.2 CPD Assessment

This section describes the second iteration of the Citizenpedia evaluation, which is centered on the CPD.

6.2.1 Evaluation setup

The goal of this test was to technically validate the CPD tool from the point of view of stability and usability, and to assess its usefulness with respect to the needs expressed by the citizens in the surveys described in Section 4.

Tests were run in November 2018 in facilities of Xunta with 22 participants. All of them were native Spanish speakers and had the following profiles:

- 4 youngsters (less than 23 years old), one of which held a bachelor degree and the other three were graduate level students.
- 13 middle-age (23-35 years old), 6 of which were postgraduate-level students and 7 were graduate-level students.
- 5 adults (36-50 years old), 1 of them being full-time a student and the rest graduate-level employees.

Participants were first provided with a step-by-step guideline (in electronic format) explaining how to interact with the CPD tool, then each of them was able to conduct the test autonomously. At the end of each interaction, participants were asked to fill out multiple-choice questionnaires aimed at assessing the overall comprehension of the tool.

The experiment consisted in presenting the participants with two views: one view was the official descriptive web page of an administrative procedure as published through the XUNTA PA portal[3]; the other view was the description of the same procedure offered through the CPD tool. The administrative procedure "Acknowledgement of the level of disability" (Xunta de Galicia e-service BS611A) was selected as use case for the experiment. Figure 6 shows a snapshot of the procedure diagram offered by the CPD tool.

Participants were requested to note the difference (if any) between the two proposed views and then were invited to explicitly interact with the CPD tool by navigating the procedure diagram and its graphical elements. Finally, participants were invited to focus on the substance of the procedure, by making specific questions and leaving their feedback through ad-hoc buttons provided by the CPD tools.

Similarly to the QAE test, information and feedback from the participants were collected using questionnaires (Google Forms) and questions/feedback posted

[3] https://simpatico.hi-iberia.es:4570/IFE/BS611A_es.html

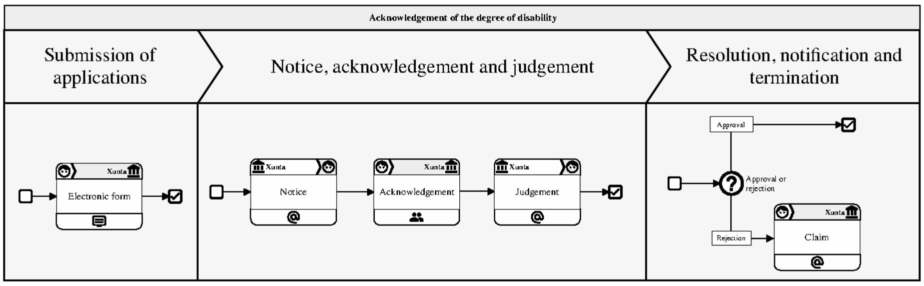

Figure 6: Screenshot of CPD's procedure "Acknowledgement of the level of disability"

by participants on the phases of each procedure. With regard to this point, being the CPD tightly integrated with the QAE, the question submissions were started by clicking on the CPD diagram phase and completed on the QAE. In addition, feedback was collected through the "submit feedback" feature of the CPD.

Participants had to fill out an *intermediate questionnaire* and a *final questionnaire*. Both questionnaires were anonymous, and all participants filled them out. The intermediate questionnaire consisted of five sections: 1) Gathering of non-sensitive data; 2) Perception of the information; 3) Comprehension of the information; 4) Effectiveness of the Information; 5) Concluding question. The final questionnaire aimed at testing the willingness of citizens - who are end users of the services offered by the Public Administration - to actively participate in the improvement of the services themselves. Participants were asked to express their opinion with respect to the possibility of posing questions and feedback on administrative procedures by means of the tools offered by the CPD.

6.2.2 Results

Once the evaluation session concluded, data were collected and analysed. In this section we report a summary of the answers and thoughts provided by participants through the questionnaires.

When it comes to assess the level of perception of the information provided by the CPD, the test outcome was quite positive. As shown in Table 14, the use of graphical symbols to describe administrative procedures was appreciated by participants and they found the CPD graphical notation quite intuitive.

A specific question was also asked to participants regarding what new information they found on the CPD view that was not already provided in the XUNTA de Galicia PA portal. In this case, participants had to provide a free-text answer. The answers have been analyzed and grouped into macro categories, whose distribution is reported in Table 15. Participants specifically appreciated:

Table 14: Participants' appreciation of the CPD tool's graphical notation

Questions	Possible Answers	Rate
Overall, how would you consider the use of symbols, images, icons to describe the services offered by the Public Administration?	I found it very useful, the graphic symbols help me to understand immediately the way the service works	41%
	I found it useful, but it is appropriate to combine them with supplementary text	54.5%
	Not useful at all, I prefer a text-only page	4.5%
How would you rate the graphical notation used in the CPD tool?	Very intuitive	68.2%
	Not very intuitive, but the legend helped me to understand it better	13.6%
	Very little intuitive	18.2%
	Not intuitive at all, and I didn't find the legend helpful either	0%

Table 15: Participants' perception of new information when using the CPD tool

Question	Possible Answers	Rate
On the CPD page, what new information did you find that was not already on the official XUNTA de Galicia PA Portal?	The sequence of the phases a procedure is split into	32%
	Almost the same information, but in a clearer way	28%
	The interaction between the citizen and the PA is clearly spotted	14%
	Other answers	26%

a) the new way of structuring information into distinct phases; b) the idea of spotting all the moments when citizens and PA get in touch.

The final questionnaire was devoted to assess the willingness of participants to play an active role in the design of new PA procedures. The CPD tool provides support features that allow citizens to post questions directly on the graphical elements of the procedure diagram. The response of participants on the usefulness of such feature is quite positive, as described in Table 16.

Regarding the possibility of experienced citizens responding to doubts posed by other citizens, the response of participant is definitely positive (see Table 17). The majority of participants are keen to share their own experience and answer

Table 16: Participants' appreciation of making on-line questions through the CPD tool

Question	**Possible Answers**	**Rate**
How would you rate the way of obtaining assistance from the Public Administration by making on-line questions through the graphical elements of the CPD diagram?	I like it, I would not waste time writing emails, making phone calls or going to the Public Administration premises	85.7%
	I do not like it, when I have doubts I prefer to speak to the Public Administration in person, by e-mail or by telephone	14.3%

Table 17: Participants' trust on each other's past experiences with the PA

Question	**Possible Answers**	**Rate**
Would you like if other citizens like you, as well as employees of the Public Administration, answered your questions?	Yes, I trust the experience of other citizens	38.1%
	No, I only trust the answers provided by the employees of the Public Administration	19%
	I would like to see both the responses of citizens and those of the Public Administration employees	42.9%
To what extent would you be available to answer the questions posed by other citizens?	Not at all available	4.8%
	Little available	28.6%
	On average available	42.8%
	Quite available	19%
	Extremely available	4.8%

other citizens' questions.

The CPD offered participants a button to send free-text comments to the PA concerning negative aspects of the procedure or possible improvements of it. They were then asked to rate the usefulness of this feedback mechanism, and the opportunity that the PA took care of such feedback. Responses to this question are shown in Table 18. There is a strong belief that the requirements to improve the services should be elicited from those who indeed use the services.

The final item of the questionnaire is a free-text field in which participants could leave any additional general purpose feedback. Comments were provided by all participants: 8 were positive, 7 were negative, 7 were improvement suggestions. We provide below the most significant improvement suggestions translated from Spanish:

Table 18: Participants' opinion on the importance that PA takes care of their feedback

Question	**Possible Answers**	**Rate**
How important do you find that suggestions from citizens are taken into consideration by the Public Administration to improve the provided services?	Not important at all	0%
	Not very important	0%
	On average important	9.5%
	Quite important	28.6%
	Extremely important	61.9%

- The size of the text describing the phase is too small;
- It would be nice if the CPD could show the stage of the procedure where my request is currently stuck.
- Provide a way to quickly access the e-service from the CPD interface;
- The list of questions and relative answers should appear in a pop-up window while the citizen moves the pointer over the phase;

As a summary, the CPD tool resulted interesting and helpful to better understand administrative procedures, but we felt that the steps of the procedures had to be described in simple terms in order to attract non-technically minded users.

7 Conclusions

In this work, we have described the Citizenpedia, a human computation mediated participatory tool aimed at fostering the electronic interaction between citizens and the government. Citizenpedia is composed of two web-based tools: the Question Answering Engine and the Collaborative Procedure Designer. The former is a collaborative space where citizens and civil servants can post and solve doubts about e-services and the PA, and the latter is a tool where citizens can collaborate with civil servants in the definition and improvement of new administrative procedures and e-services.

We have described a first design evaluation of Citizenpedia conducted as a set of online surveys. These surveys contained some mock-up videos and a set of questions, and they were distributed among three regions in three different countries. They were filled by 152 citizens and 63 civil servants, and from the results we gathered that the overall idea of the Citizenpedia had a high potential according to the opinion of participants, providing that several usability and engagement aspects were taken into account.

After that, we have presented a user-based evaluation of the Citizenpedia's prototype, which was conducted in two iterations. The first iteration was focused on the QAE, and it was conducted by 188 citizens and 16 civil servants from the region of Galicia, Spain. The participants tested the funcionalities of the QAE linked to two e-services of Xunta, the government of Galicia. From the results of the evaluation we draw the conclusion that QAE in Citizenpedia is an attractive tool for the users, but that development efforts have to be put in place to make it more usable and accessible.

The second iteration of the evaluation was conducted by 22 participants and its aim was to assess the CPD tool. In this case, participants tested its usefulness and ease of use following the same evaluation methodology as in the first iteration. Results for this iteration showed that participants found the CPD attractive, but also pointed at a two major issues: one was poor rendering of texts, and another one was some difficulty to understand the CPD's process-based view.

Drawing on the conclusions from these tests, the first line of future work will be the re-design and implementation of several features based on the comments from the user-based evaluation. Many details have to be polished and other features re-engineered, specially the ones that have to do with accessibility. For example, citizens got confused when they accessed the Citizenpedia component from the e-service due to the required cognitive workload to switch between components' contexts (from e-service to Citizenpedia and vice versa). The QAE web page is opened in a new tab and they had problems to go back to the e-service information.

In order to solve this problem two new features will be implemented. The first one will give the possibility to the citizens to create new question and answers on the e-service page. The second one might give place to a new tool where the information about the administrative procedures, e-services and all the question and answers related to them will be shown. This way all the questions and answers will be contextualized and navigation between procedure, e-service, questions and answers will be streamlined. This tool will also improve the QAE and CPD integration in order to reduce context switching between both tools. Drawing from the results of the CPD assessment, the readability of texts and graphical elements will be improved.

Further work will also analyse the impact of contributors in Citizenpedia, and more specifically it will consider the problem of the Expert Finding, i.e., to be able to identify the people with relevant knowledge in a certain topic that will provide the best answers to a certain question [Neshati et al., 2017].

The source code of Citizenpedia is publicly available in [SIMPATICO, 2018].

Acknowledgments

This work has been financially supported by the European Commission under the Horizon 2020 funding programme, project SIMPATICO (H2020-EURO-6-2015, grant number 692819). Authors would like to thank Carmen Orgeira, Noelia Lopez and Pura Vazquez from Xunta de Galicia for their aid in the experimental sessions.

References

[AmazonMechanicalTurk, 2018] AmazonMechanicalTurk (2018). Amazon mechanical turk. `https://www.mturk.com/`. [Online; accessed 31-December-2018].

[Androutsopoulou et al., 2018] Androutsopoulou, A., Karacapilidis, N., Loukis, E., and Charalabidis, Y. (2018). Transforming the communication between citizens and government through ai-guided chatbots. *Government Information Quarterly*.

[Asquer, 2014] Asquer, A. (2014). Not just videogames: Gamification and its potential application to public services. *Digital Public Administration and E-Government in Developing Nations: Policy and Practice*.

[Bista et al., 2014] Bista, S. K., Nepal, S., Paris, C., and Colineau, N. (2014). Gamification for online communities: A case study for delivering government services. *International Journal of Cooperative Information Systems*, 23(02):1441002.

[Charalabidis et al., 2014] Charalabidis, Y., N. Loukis, E., Androutsopoulou, A., Karkaletsis, V., and Triantafillou, A. (2014). Passive crowdsourcing in government using social media. *Transforming Government: People, Process and Policy*, 8(2):283–308.

[Charalabidis et al., 2012] Charalabidis, Y., Triantafillou, A., Karkaletsis, V., and Loukis, E. (2012). Public policy formulation through non moderated crowdsourcing in social media. In *Proceedings of the 4th International Conference on Electronic Participation (ePart 2012), Kristiansand, Norway*, pages 156–169. Springer Berlin Heidelberg.

[Claver Cortés et al., 2015] Claver Cortés, E., Espinosa, J., Valdés Conca, J., et al. (2015). Revisiting the technological and non-technological challenges to municipal e-government in spain.

[Dargan and Evequoz, 2015] Dargan, T. and Evequoz, F. (2015). Designing engaging e-government services by combining user-centered design and gamification: a use-case. In *Proceedings of The 15th European Conference on eGovernment ECEG 2015 University of Portsmouth*, page 70.

[De Cindio and Stortone, 2013] De Cindio, F. and Stortone, S. (2013). Experimenting liquidfeedback for online deliberation in civic contexts. In Wimmer, M. A., Tambouris, E., and Macintosh, A., editors, *Electronic Participation*, pages 147–158, Berlin, Heidelberg. Springer Berlin Heidelberg.

[Engiel et al., 2014] Engiel, P., Araujo, R., and Cappelli, C. (2014). Designing public service process models for understandability. *Electron. J. e-Government*, 12(1):95–111.

[Havery and Lloyd, 2016] Havery, I. and Lloyd, N. (2016). Lost visions: a descriptive metadata crowdsourcing and search platform for nineteenth-century book illustrations. In *Studies in the Digital Humanities-Proceedings of the Digital Humanities Congress 2014*. HRI Online Publications.

[Lintott et al., 2008] Lintott, C. J., Schawinski, K., Slosar, A., Land, K., Bamford, S., Thomas, D., Raddick, M. J., Nichol, R. C., Szalay, A., Andreescu, D., Murray, P., and Vandenberg, J. (2008). Galaxy zoo: morphologies derived from visual inspection of galaxies from the sloan digital sky survey*. *Monthly Notices of the Royal Astronomical Society*, 389(3):1179–1189.

[Luengo-Oroz et al., 2012] Luengo-Oroz, M. A., Arranz, A., and Frean, J. (2012). Crowdsourcing malaria parasite quantification: an online game for analyzing images of infected thick blood smears. *Journal of medical Internet research*, 14(6).

[McNutt, 2014] McNutt, K. (2014). Public engagement in the web 2.0 era: Social collaborative technologies in a public sector context. *Canadian Public Administration*, 57(1):49–70.

[Michelucci, 2013] Michelucci, P. (2013). *Handbook of Human Computation*. Springer Publishing Company, Incorporated.

[MORElab Research Group, 2016a] MORElab Research Group (2016a). Citizenpedia CPD citizen mockup. `https://youtu.be/tZbwD8vPx-E`. [Online; accessed 15-March-2018].

[MORElab Research Group, 2016b] MORElab Research Group (2016b). Citizenpedia CPD civil servant mockup. `https://youtu.be/rXbV9wQcxmo`. [Online; accessed 15-March-2018].

[MORElab Research Group, 2016c] MORElab Research Group (2016c). Citizenpedia QAE mockup. `https://youtu.be/TyP38M1cFrc`. [Online; accessed 15-March-2018].

[Neshati et al., 2017] Neshati, M., Fallahnejad, Z., and Beigy, H. (2017). On dynamicity of expert finding in community question answering. *Information Processing & Management*, 53(5):1026 – 1042.

[PaizaQA, 2016] PaizaQA (2016). PaizaQA code repository. `https://github.com/gi-no/paizaqa`. [Online; accessed 15-March-2018].

[Parsons, 2017] Parsons, A. (2017). Whatdotheyknow and central government foi.

[Pe-Than et al., 2015] Pe-Than, E. P. P., Goh, D. H.-L., and Lee, C. S. (2015). A typology of human computation games: an analysis and a review of current games. *Behaviour & Information Technology*, 34(8):809–824.

[Prpic et al., 2015] Prpic, J., Taeihagh, A., and Melton, J. (2015). The fundamentals of policy crowdsourcing. *Policy & Internet*, 7(3):340–361.

[Quinn and Bederson, 2011] Quinn, A. J. and Bederson, B. B. (2011). Human computation: A survey and taxonomy of a growing field. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '11, pages 1403–1412, New York, NY, USA. ACM.

[Quinn and Bederson, 2014] Quinn, A. J. and Bederson, B. B. (2014). Asksheet: Efficient human computation for decision making with spreadsheets. In *Proceedings of the 17th ACM Conference on Computer Supported Cooperative Work & Social Computing*, CSCW '14, pages 1456–1466, New York, NY, USA. ACM.

[SIMPATICO, 2018] SIMPATICO (2018). Citizenpedia code repository. `https://github.com/SIMPATICOProject/citizenpedia`. [Online; accessed 15-March-2018].

[Smart Community Lab, 2018] Smart Community Lab (2018). SmartCampus Gamification Engine. `https://github.com/smartcommunitylab/smartcampus.gamification`. [Online; accessed 15-March-2018].

[Thalos, 2015] Thalos, M. (2015). Who will advise us? *SATS*, 16(1):67–95.

[Torres et al., 2005] Torres, L., Pina, V., and Royo, S. (2005). E-government and the transformation of public administrations in eu countries: Beyond npm or just a second wave of reforms? *Online Information Review*, 29(5):531–553.

[Von Ahn, 2005] Von Ahn, L. (2005). *Human Computation*. PhD thesis, Pittsburgh, PA, USA. AAI3205378.

[Walravens, 2013] Walravens, N. (2013). Validating a business model framework for smart city services: The case of fixmystreet. In *2013 27th International Conference on Advanced Information Networking and Applications Workshops*, pages 1355–1360.

[Xunta de Galicia, 2018a] Xunta de Galicia (2018a). BS607A - Programa Bienestar en Balnearios. `https://sede.xunta.gal/detalle-procedemento?codtram=BS607A`. [Online; accessed 15-March-2018].

[Xunta de Galicia, 2018b] Xunta de Galicia (2018b). BS613B - Ayudas individuales para la adquisición de servicios de promoción de la autonomía personal y la adquisición de servicios complementarios de asistencia personal, para personas con discapacidad. `https://sede.xunta.gal/detalle-procedemento?codtram=BS613B`. [Online; accessed 15-March-2018].

[Xunta de Galicia, 2019] Xunta de Galicia (2019). BS611a - Reconocimiento del grado de discapacidad. `https://sede.xunta.gal/detalle-procedemento?codtram=BS611A`. [Online; accessed 14-January-2019].

[Yap et al., 2017] Yap, C. S., Ahmad, R., Mason, C., and Newaz, F. T. (2017). Satisfaction with e-government portals: Perspective of senior citizens. In *KMIS*.