PONTIFICIA UNIVERSIDAD CATOLICA DE CHILE
SCHOOL OF ENGINEERING

USER EXPERIENCE MONITORING:

A PATH TOWARDS QUALITY OF SERVICE IN THE EDUCATIONAL SYSTEM

LEONARDO ANDRÉS MADARIAGA BRAVO

Thesis submitted to the Office of Graduate Studies in partial fulfilment of the requirements for the Degree of Doctor in Engineering Sciences.

Advisor:
MIGUEL NUSSBAUM VOEHL

Santiago, Chile, August 2018

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To Carolina, Alonso and Felipe,

for their support and providing purpose

to this journey

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LEONARDO ANDRÉS MADARIAGA BRAVO

RESUMEN

En un sistema de entrega de información compuesto por actores heterogéneos que se informan entre sí en diferentes niveles, la calidad del servicio se relaciona con un equilibrio general entre las necesidades y los objetivos del usuario y del proveedor de la información.

En la última década, el flujo de artefactos de información, en cualquier contexto, se ha incrementado significativamente: desde datos simples, figuras, tablas, hasta informes organizados, formularios, sitios web, plataformas de datos abiertos, aplicaciones, entre muchos otros. A pesar de una serie de esfuerzos para garantizar el acceso, la estandarización y la facilidad de uso, gran parte de los artefactos de información no cumplen con un uso efectivo. En el contexto de esta tesis la visión general apunta a que para garantizar el uso de la información, los proveedores de información deben recibir retroalimentación constante por parte de los usuarios para comprender si realmente se cubren sus necesidades de información. Se generó y probó un modelo para el Monitoreo de la Experiencia del Usuario dentro del Sistema Educativo de Chile, que abarca artefactos de interactividad de bajo nivel en dos tipos de interacción: Gobierno a Instituciones Educativas e Instituciones Educativas a Estudiantes. Esta tesis proporciona un modelo y herramienta para comenzar a implementar procesos centrados en el usuario en el

contexto de la entrega de información pública para avanzar hacia la Calidad de Servicio, debido a que las organizaciones tanto públicas como eudativas pueden mejorar el diseño de sus artefactos de información en base a una mejor comprensión de sus usuarios.

Palabras clave: experiencia de usuario, monitoreo, artefactos de información, información de servicio público, calidad de la información, interacción con computadora humana.

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ABSTRACT

In a system of heterogeneous actors informing each other in different levels, Quality of Service relates to an overall balance between the needs and goals of the information user of government information (e.g. documents, patents, reports, among many others) and the information provider (i.e. public services). In the last decade the stream of information artifacts, in any context, has augmented significantly: from simple data, figures, tables, to organized reports, forms, websites, open data platforms, apps, among many others. Despite a series of efforts to ensure accessibility, standardization and ease of use, much of the information artefacts does not meet effective usage. In the context of this thesis, the general vision is that it in order to ensure information usage, information providers need to have constant feedback from users to understand if their information needs are being actually covered. A model for User Experience Monitoring was generated and tested within Chile's

Education System, covering low-level interactivity artifacts in two types of interaction: Government to Educational Institutions and Educational Institutions to Students. This thesis provides a model and tool to start implementing user-centered processes in the context of information delivery towards advancing to Quality of Service, due to the fact that organizations can improve the design of their information artifacts based on a greater comprehension of their users.

Keywords: User Experience, Monitoring, Information Artifacts, Public Service Information, Information Quality, Human Computer Interaction.

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1. INTRODUCTION

1.1 Conceptual framework: Information Artifact

In the context of e-government, user-centered evaluation has been implemented as a medium to improve the quality of the service (Kumar et al, 2017). However, in this context citizen consultations are applied mainly to information products with higher levels of interactivity such as websites, portals or mobile applications (Wani et al, 2017). Less attention has been made to those products with lower levels of interactivity, such as digital or paper-based forms (two-way interactivity) or non-interactive products such as text-based reports, laws, maps, infographics and documentation in general. The latter, still represent a large part of the user experience with regards to public services, particularly in context where citizen information needs revolve around access to content, either digital or non-digital.

Organisms such as the United Nations has stated diverse concerns with regards to the low level of usage of information products delivered by public services, stating:

"The data itself has no value. Innovative strategies are needed to increase the use of data and promote a demand-driven perspective. Other requirements for the use of data are: accessibility, reliability, accuracy and usability of the data, knowledge and confidence in the data shared by governments.

(United Nations, 2016)

A considerable body of research has studied dimensions affecting efficient information usage: digital inclusion (Mesa & Martínez-Monje, 2013), information literacy (Cestnik & Kern, 2014), information seeking behaviors (Wang & Chen, 2012), among others. This

asymmetry, between information provision and information usage drive the main problem confronted by this thesis, which has been stated as:

How can an organization improve the User Experience of the information artifacts it generates?

In this work, we will understand "information artifact" as a sub-component of the Information System construct. In the framework proposed by Lee et al (2015), the Information System Artifact is the resulting interaction between the "technology artifact", the "information artifact" and the "social artifact". Each of this components are defined as:

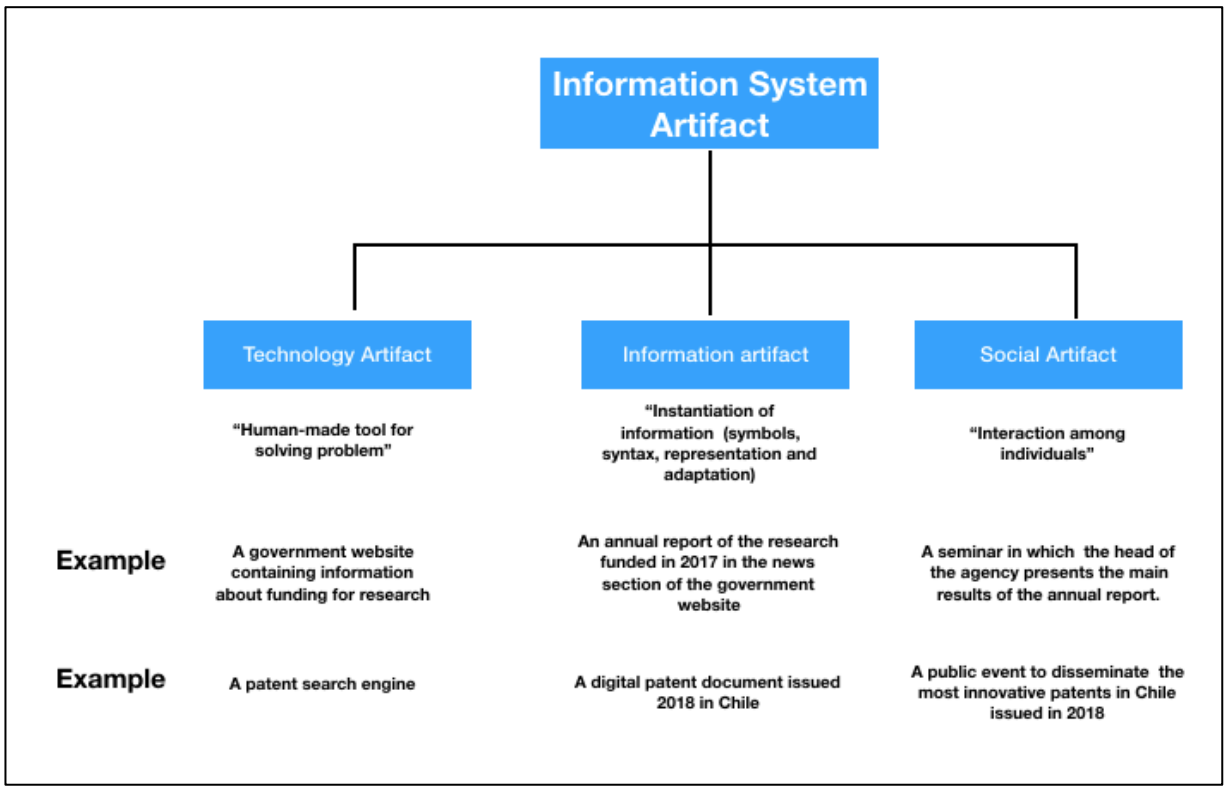
- *Technology artifact: human-created tool whose main reason to exist is to solve a problem, achieve a goal or serve a purpose that is human defined, human perceived or human felt. Technology artifacts may include not only those that are described as digital or electronic (such as a mobile phone, a FaceBook page, a memory stick, a pdf file and a hardware-software-data-network system) but also those that are non-digital and non-electronic (such as a face-to-face meeting, a billboard, a person's memory, a book and a library)*
- *Information artifact: an instantiation of information, where the instantiation occurs through a human act either directly (as could happen through a person's verbal or written statement of a fact) or indirectly (as could happen through a person' s running of a computer program to produce a quarterly report). Examples of information artifacts are (1) numbers, letters or other symbols that are themselves devoid of content (hence, 'tokens'), but to which content can be described and with which the content can then be processed; (2) relationships among numbers,*

letters or other symbols (literally, a 'syntax'), of which a special case is the algebraic relationships among variables and constants in an equation and another special case is the grammatical relationships among words and punctuation marks in a sentence or paragraph; (3)accounting numbers that form the meaning of (and therefore are a 'representation' of) a real world financial situation; and (4) a perception or observation of a 'difference that makes a difference' in a system.

- *Social Artifact: artifact that consists of, or incorporates, relationships or interactions between or among individuals through which an individual attempt to solve one of his or her problems, achieve one of his or her goals or serve one of his or her purposes. We describe this artifact as social because relationships and interactions involve more than just one person; hence, they involve the social, not just the individual. Defined in this way, social artifacts can include persistent social objects that involve already established relationships (such as kinship structures, institutions, roles, cultures and laws) as well as one-off ephemera in one-off interactions (such as an utterance in a conversation, a decision made in a committee meeting, a purchase made in a retail transaction and a charitable act).*

This definition broadens the perspective of the design of an informational experience, providing equal importance to measuring the user experience of an information system, separating, technology used for the communication (i.e website), information artifact (i.e. content of the website) with the social interaction around the system (i.e. website demo provided by a person). The scope of this thesis is to understand the interaction with information artifacts, as depicted in figure 1.

Figure 1. Information System components

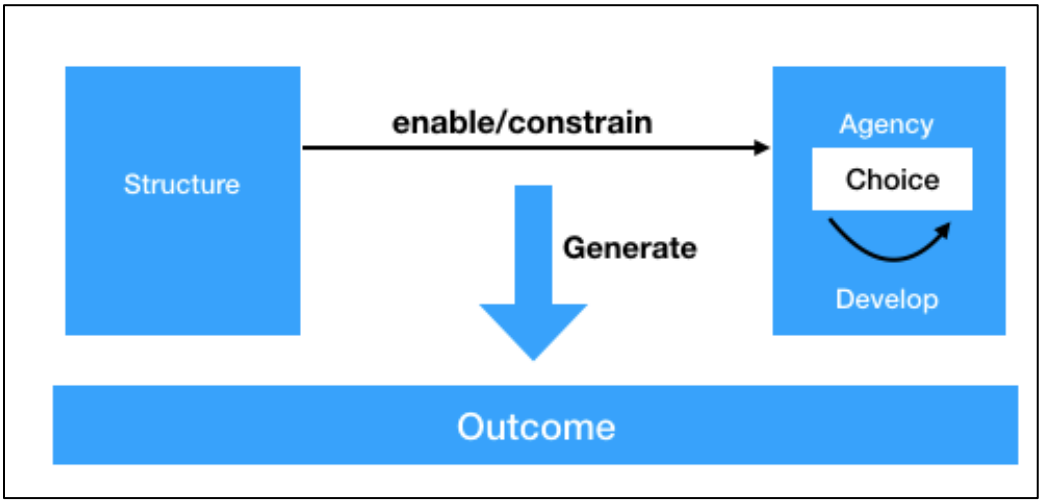


An important consequence of using this conceptual framework, is that enhancing User Experience of a government information system is not only related to measuring and re-designing the technological artifact (i.e. government website, portal), but it also requires a systemic enhancement action covering the other two components, the information artifact (i.e. the content of the website) and the social artifact (i.e. the face-to face events that are used to disseminate the website and its content).

1.2 User Experience and Quality of Service

As public sector moves towards greater integration of Information and Communication Technologies (ICT) in its service provision, citizen can acquire greater access to tools, content and processes to enhance their quality of life (Bell & Nusir, 2017). Based on Kleine´s Choice Framework (2010) this technology-enhanced service can be conceptualized as a greater degree of "empowerment" of public services. Empowerment of an organization will relate to the degree of choices available, in other words major empowerment will lead to major degrees of freedom and the ability to adapt the service to the context of action. The choice framework is depicted in figure 2.

Figure 2. Choice framework



The framework consists of four main constructs (Kleine, 2010):

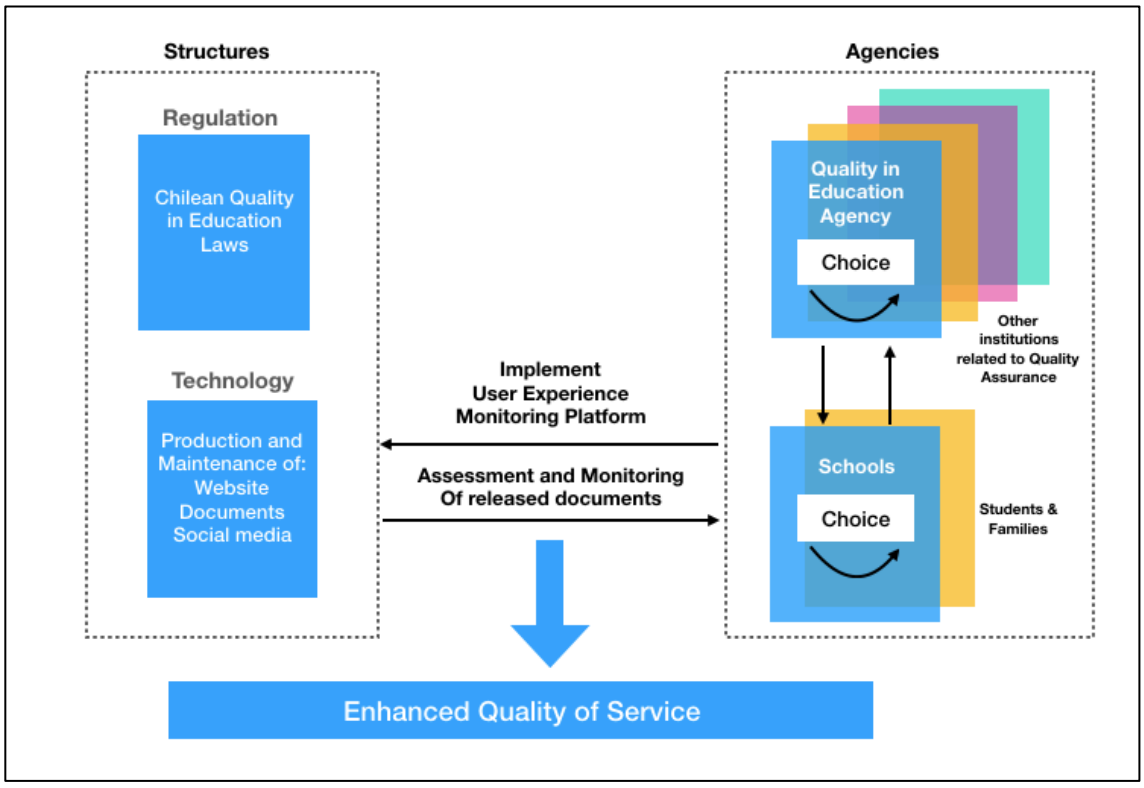
- *Agency* — It is an entity which possesses some abilities and relies on different kinds of resources as inputs to achieve its goals. The resources comprise: material resources like machinery, equipment and other inputs to production processes; financial resources such as cash and shares; natural resources such as local climate and

available minerals; geographic resources related to the physical location of the agency; as well as human, psychological, informational, cultural and social resources. According to this model, an Agency is the subject of development.

- *Choice* — It represents a degree of empowerment of an Agency determined by the combination of its resources and structural conditions. The model defines four levels of Choice: 1) existence of Choice — Agency has access to resources, 2) sense of Choice — Agency is able to assess and decide on the relevance of existing resources, 3) use of Choice — Agency is able to determine how to use resources to achieve its goals, and 4) achievement of Choice — Agency is able to act and achieve its goals.
- *Structure* — It includes formal and informal laws, rules, regulations, norms, customs, culture, policies, institutions and processes. The framework also includes discourses as Structures as rules, laws, norms, policies, etc. often emanate from them and are embedded in them. In general, a Structure enables or constrains an Agency in the attainment of its goals.
- *Outcome* — According to the Capability Approach, the primary development Outcome is the choice itself. The secondary Outcome depends on the Agency's choice informed by its underlying values, for example whether the Agency values more communication, knowledge, income, voice, time, etc. Achieved at the Agency level, such Outcomes could be aggregated at the national or international level where MDG are formulated and measured. For instance, increased income at the Agency level directly contributes to poverty reduction at the community, national and international levels.

This conceptual framework is a useful tool in this thesis since it is able to link the action of User Experience monitoring to a greater effect, such as the enhancement of the quality of service, while at the same time being able to depict the interaction of the information provider with the users and the regulatory and technological structure. Figure 3, depicts the use of the Choice framework with regards to the quality assurance of the educational system in Chile.

Figure 3. Choice framework extended to the thesis



In the particular domain of this thesis, the user experience monitoring of documentation delivered by a public information provider to a user, will have the choice effect over the ability to design, re-design, preserve or discard information artifacts that are in current use.

1.3 General and Specific Goals of the thesis project

In a global context where government services are becoming increasingly demanded, there is a need to develop models that address the usage of multiple information artifacts for a variety of users and needs. However, public agencies are not traditionally user-centered in terms of their information-goal setting (Henninger, 2017). In this sense, the present project seeks to address this "gap" through the following general objective: To develop a model that allows to systematically evaluate and monitor the user experience of information artifacts delivered from an information provider to a user. For this it is necessary to cover the following specific questions:

- How can the information items be ordered in relation to the user experience?
- How can the user experience of public information items be monitored continuously?
- How does ordering and monitoring influence the management of the user experience in a public organization?

These questions lead to the general structure of goals and hypotheses of the thesis:

Goal 1: Develop a representation model of the information artifacts of an organization in relation to the self-assessment of the user dimensions.

Hypothesis 1: A methodology that organizes the information artifacts according to User Experience and Usability criteria allows to guide the development of information items of an organization towards an improved quality of service

Goal 2: Define a systematic survey methodology for users in relation to the usability of the information products of an organization

Hypothesis 2: The action of monitoring user dimensions implies a progressive increase in user-centered practices in the organization

Goal 3: Validate the model of representation, survey and indicators with a Chilean public organization that has a relevant presence in terms of digital government

Hypothesis 3: A methodology that classifies the information artifacts according to user dimensions allows to guide the design (or re-design) of information artifacts of an organization

1.4 Quality Processes in Education & Information demand

In the last decade a significant number of countries have moved towards the implementation of national systems for administering Quality Processes in Education (Steinhardt et al, 2017). A consistent characteristic of these systems has been a steady increase in the flux of

information produced by government actors in order to support monitoring processes in Education (Sherman, Bosker & Howie, 2017).

Chile has not been the exception. In year 2011, under a new legislation, a National system of Quality Assurance was defined, shifting mainly from one governing institution (Ministry of Education) to a system of actors with different roles interacting with Higher Education and the School System, in order to enhance policy, regulation and to respond to the challenges of Quality in a highly diversified and unequal system (Cabalin, 2012; Tuchman, 2017).

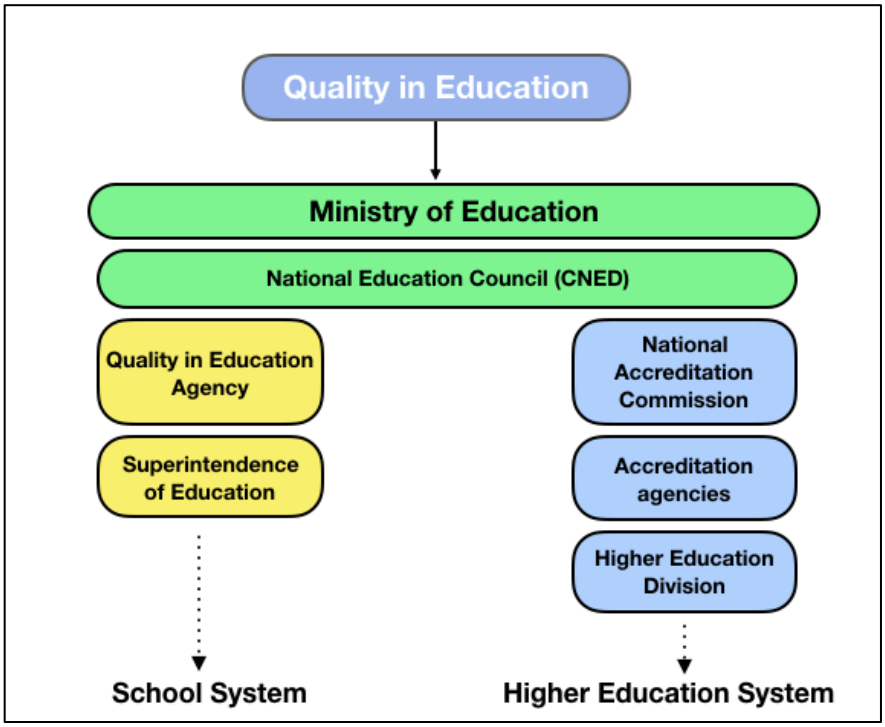
In the new structure (see Figure 1), the Ministry of Education maintains its directive role in terms of policy, regulation and public educational budget, but new public services were added to the general scene of decision making. In the School system, there are three additional actors (Cox, 2012):

a) National Education Council (CNED): Its main objectives are: definition of a standard curriculum and study programs, assessment plans, learning standards, quality indicators, recognition of educational institutions, teacher development, among others.
b) Quality in Education Agency (ACE): Its main goal is to implement process for evaluation and guidance of the educational system so that it tends to improve the quality and equity of educational opportunities
c) Superintendence of Education: A public service with the core mission to contribute to the assurance of quality and exercise of the right to early childhood and school education, by monitoring compliance with regulations; accountability; the management of complaints and the provision of information with a sense of efficiency, effectiveness, transparency and participation.

On the other hand, the new legislation also brought new actors to the Higher Education system (OCDE, 2013):

- Higher Education Division: Is a division of the Ministry of Education, responsible for ensuring compliance with laws and formally recognizes higher education institutions. Its other main function is to collect and disseminate information, a task that is carried out through the new Higher Education Information Service (SIES).
- National Education Council (CNED): The national council also interacts with Higher Education agents with the core mission of: managing of the licensing process, the appointment of those responsible for carrying out the peer review, the provision of information and the processing of the appeals filed in relation to the accreditation decisions.
- National Accreditation Commission (CNA): Manages the accreditation, sets the accreditation criteria, implements the institutional accreditation, authorizes the Accrediting Agencies and provides public information.
- Accreditation agencies: Private non-profit organizations that are responsible for the accreditation of careers. They need the authorization of the CNA to exercise their activity in certain series of areas of knowledge and academic levels.

Figure 4. A new framework for Quality Assurance in Chile



The goal of the Chilean Quality in Education system is based on supporting new processes of self-assessment, external assessment, inspection, testing, guidance and support for planning and implementation of Quality enhancement plans (Río, Rojas & López, 2016).

In this scenario, Quality Assurance is an evaluation process directed towards "quality levels", in which the need for organized data and information becomes fundamental to monitor the educational process based in "quality indicators and numbers" (Lingard, 2011). In literature, the need to use public information and data by educational actors has been related to a variety of dimensions such as: aspects of organizational legitimation (Lascoumes & Le Galès 2007), school governance capabilities (Ozga, 2009), improvement of administrative and learning process (Jin, 2013) and data-driven practices (Lewis & Holloway, 2017). Therefore, the type information artifacts in the interaction between Government and Educational system has become a complex system of information artifacts ranging from data-driven documents,

guidelines, reports to online platforms and web-repositories. In many administrative levels, public services have become accountable of the information artifacts they produce, driving attention to the idea that organized and methodic feedback about the work of public services is essential for evidence-informed decisions (Kroll, 2015). A crucial effect of this, is that any information provider in this system, from a public agency to an instructor in the classroom, is meeting the need to assess if the information they produce is strategically aligned to organizational goals (Luftman, Lyytinen & Zvi, 2017)

1.5 Information for Quality: stakeholders and interactions

The notion of "quality" in education is broad and has been largely discussed in literature (Filippakou, 2011). In an ample perspective, it has been related to the need that educational institutions display operational transparency (particularly when being publicly funded), responsiveness to societal challenges and responsible with regards to national development goals (Cowen, 2018).

Gvaramadze (2008) describes a model in which the need to establish an agreement with regards to the concept of "Quality" in education has been related to two core concepts to frame the processes involved: *"quality as enhancement (process of changing institutions) and quality as transformation (process of changing individuals)"*. In terms of relating the quality process to actors and levels, the author defines two levels:

1) *"Institutional level — a structural and managerial element in order to enhance quality and coordination of members. This refers to quality as an enhancement process."*

2) *"Individual/staff level — cultural and psychological level of shared values, beliefs, expectations and commitment towards quality culture among individuals. This refers to quality as a transformation process"*

In the particular case of Chile's Quality in Education System it is possible to observe that the information artifacts produced by public services relate mostly to this bi-dimensional perspective of quality in which the main interactions are centered in the institution-individual interaction (e.g teacher-student, school principal-teachers) and government-institution interaction (e.g agency-school governing boards). However, from a governance perspective (Ozga, 2009), there's a third quality level that provides an important liaison between government and citizens. In this third interaction space, government agencies relate directly to students and their family space, which has emerged as an important element of information needs related to Quality in Education (Kanji, Malek & Tambi, 1999). Based on a triangular relationship model among E-Government, E-Business and Citizens proposed by Fang (2002), it is possible to frame a structure of relationships for information flux and information levels in a Quality in Education system (Figure 2), considering the following three actors:

- **Quality in Education Agents:** Represent all the different public services structuring the system of Quality (for School and Higher Education).
- **Educational Institutions:** Represent the entire universe of educational institutions (both public and private) and at any level (School system, Higher Education). Internally, these actors are mainly represented by governing boards (Principals, Rectors, Management teams) and educational agents (Teachers, Technical-

Pedagogical Teams, Career Guidance teachers, Learning Support Teachers, among others).

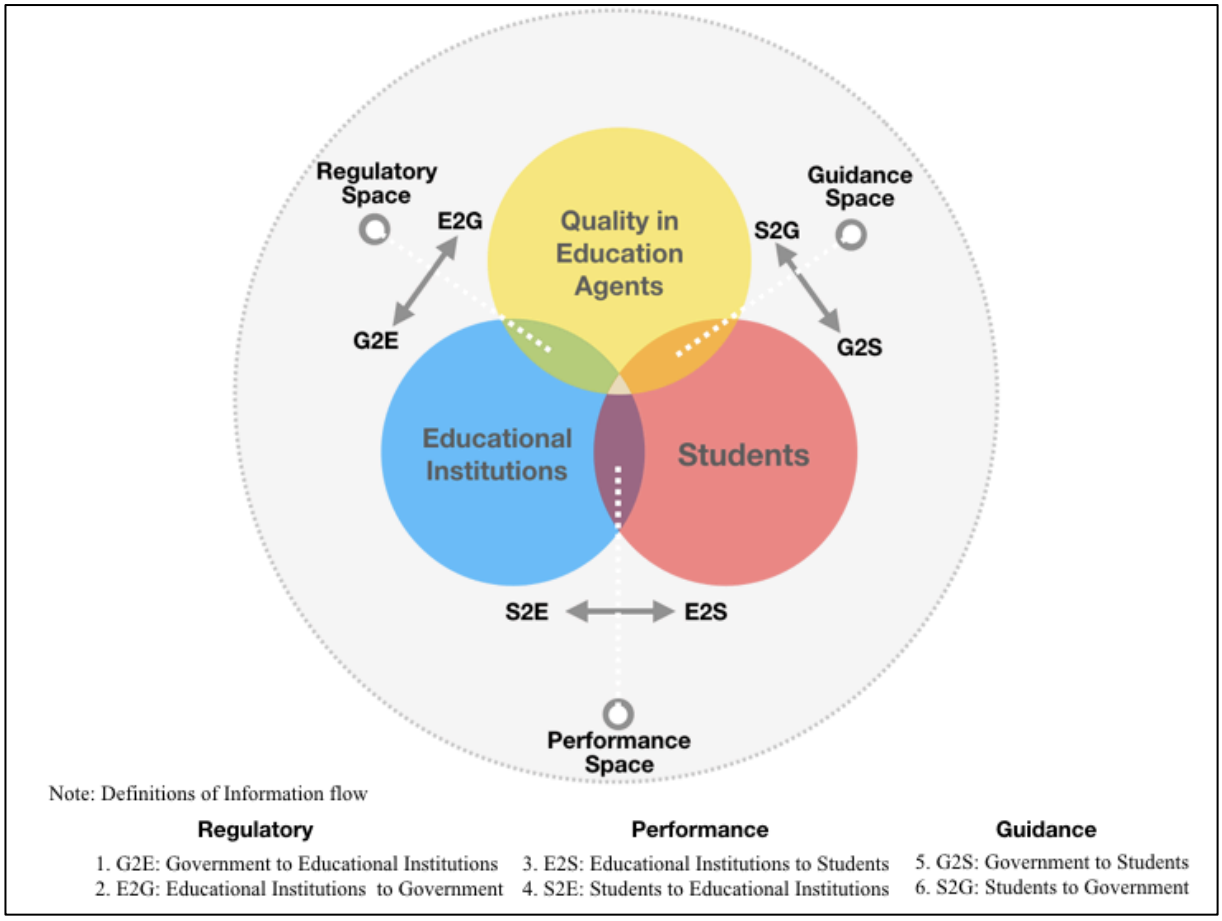
- **Students:** Represent an heterogeneous group across the School and Higher Education systems. When considering information for career or school- choice, this group also includes the family space of students (Kanji, Malek & Tambi, 1999).

Among these actors, three interaction spaces define the types of information artifacts and processes that relate to quality in terms of enhancement or assurance (Gvaramadze, 2008):

- **Regulatory space - Quality as Enhancement:** Related to information and processes directed towards enhancing managerial processes at strategic and administrative level in Educational Institutions. The main interaction goals with information artifacts are related with data-driven decisions, internal benchmarking with peer institutions, institutional goal-setting and accountability, among many others.
- **Performance space - Quality as Transformation:** Related to information and processes directed towards enhancing learning and teaching processes at classroom level. The main interaction goals with the information artifacts are related with student course evaluations, educational technology assessment, new strategies for effective learning, grading and outcomes among many others.
- **Guidance space - Quality as Support:** Related to information and processes directed towards enhancing sense of influence and contingency (Grimsley & Meehan, 2007) which provide public value to the services provided by the government. The main

interaction goals with the information artifacts are related with school-choice, career guidance, university benchmarking and economical support, among many others.

Figure 5. Information flow and levels within the Quality in Education System



The types of information flow between each actor can be defined in 6 categories relating the three main actors of this triangular model.

Regulatory Space

1. **Government to Educational Institutions (G2E):** Exchange of information to support quality assurance and enhancement processes within educational institutions.

2. **Educational Institutions to Government (E2G):** Information related to processes of accountability of internal administrative and learning processes.

Performance space

3. **Educational Institutions to Students (E2S):** Information related to support teaching and learning, standardized processes and evaluations of learning outcomes.
4. **Students to Educational Institutions (S2E):** Information related to provide feedback to the education provider in terms of its education provision.

Guidance Space

5. **Government to students (G2S):** Information for orienting decisions for educational institution selection and career guidance.
6. **Students to Government (S2G):** Information evidencing the specific needs of students and their families with regards to the expected quality of the educational institution in which they participate.

Each of these categories relate to the exchange of information artefacts over time,

Table 1, displays a set of Information Artifacts that links with the particular context of Quality in Education in Chile. It is possible to observe a wide range of information artifacts, from static images (infographics) to dynamic search engines. Consequently, further understanding of the User Experience within the Quality of Education System was linked with an interactivity framework in which it is possible to relate information artifacts to their communicative and interactive nature.

Table 1. Examples of information artifacts in the Quality of Education System

Information Artifact	Delivered by	Delivered for	Space	Type of Information flow	Description
Quality in Education Magazine	National Education Council	School Governing Boards and Educational Agents	Regulatory	1. Government to Educational Institutions (G2E)	Biannual publication, founded in 1993, which provides up-to-date information on innovations and recent debates in the field of education -in all its levels- in Chile and the world. http://www.revistadeeducacion.cl
Higher Education Indicators	National Education Council	Universities Governing Boards	Regulatory	1. Government to Educational Institutions (G2E)	Series of data bases, graphical visualizations and reports covering aspects such as: total enrollment, retention, infrastructure. https://www.cned.cl/indices-educacion-superior
"Good School" Search Engine	Superinten-dence of Education	School Governing Boards and Educational Agents	Regulatory	1. Government to Educational Institutions (G2E)	Access the normative obligations of educational establishments https://www.buenaescuela.cl/mvc/bienvenida/index
Reading Motivation Presentation	Quality in Education Agency	Teachers and Parents	Performance	1. Government to Educational Institutions (G2E)	Downloadable presentation to orient teacher and parents on how to promote reading practices in kids http://archivos.agenciaeducacion.cl/ACE_Taller_Apoderados_01_Motivara_la_lectura.pdf
Annual Technical Report	Schools	Ministry of Education	Regulatory	2. Educational Institutions to Government (E2G)	Schools must upload a report on how they have used public funding related to subsidy http://www.comunidadescolar.cl
Massive Open Online Courses (MOOCs)	Educational Institutions	Students	Performance	3. Educational Institutions to Students (E2S)	Respond to Institutions goal to enhance quality in education through online education. An example is: https://www.coursera.org/uchile
Course Assessment	Higher Education Students	Academic Departments	Performance	4. Students to Educational Institutions (S2E)	Students must assess the quality of teaching, learning materials, infrastructure and teaching assistants of the courses they take each semester. Universities provide online platforms for this purpose. Some particular examples are: http://www.uchile.cl/portal/presentacion/vicerrectoria-de-asuntos-economicos-y-gestion-

					institucional/convenio-de-desempeno/sistemas-de-gestion/96393/encuesta-docente http://direcciondedesarrolloacademico.uc.cl/index.php?option=com_content&view=article&id=391&Itemid=419
Assessments of Ethical Aspects	Doctoral Students	Institutional Review Boards	Performance	4. Students to Educational Institutions (S2E)	Quality of Doctoral research is related to the Process of Institutional Review Boards. Doctoral students must submit their research through online platforms such as: https://evaluacionetica.uc.cl/#!/login
"My Future" Portal	Higher Education Division	Students (and parents)	Performance	5. Government to Students (G2S)	Access employability data for undergraduate programs in Chile. http://www.mifuturo.cl
Infographics	Quality in Education Agency	School Governing Boards, Educational Agents, Students and Parents	Guidance	5. Government to Students (G2S)	A set of graphical schematics for explaining various concepts and processes around Quality in Education, directed towards parents and students. http://www.agenciaeducacion.cl/orientacion/herramientas-de-orientacion/infografias/
Unique Form of Socioeconomic Accreditation	Higher Education Students	Ministry of Education	Guidance	6. Students to Government (S2G)	Students must complete this form in order to apply for public grant to support their education. http://www.gratuidad.cl

1.6 Usage of Information Artifacts: Levels of interactivity

"Although two separate concepts, the notion of information is closely related to the notion of interactivity, as interactivity is all about the transmission of information in a process of communication"
(Ariel and Avidar, 2015)

The information flow between agents in the regulatory, performance or guidance space, can be conceptually framed as a process-related interaction between a sender and a receiver (Rafaeli, 1988). This communication process will be enabled by the degree of interactivity of the medium (Stromer-Galley, 2004). Early on Bretz (1983) defined "interactivity" as a quasi-interaction between a user-system or user-document interaction. Since then, a practical approach adopted by scholars has been to distinguish between two dimensions (o´neill, 2008):

- **Medium interactivity,** related to the definition by Bretz in which the focus is on the interactivity allowed by the content of a system/document. The communication process based on the nature of the technology itself and what the technology allows users to do. This perspective is consistent with a human–computer interaction (HCI) approach in which the construct of "interactivity" is the result of how the interface design is characterized.
- **Human interactivity,** also known as user-to-user or interpersonal interactivity, is the communication between two or more users that takes place through a communication channel.

Additionally, in terms of medium interactivity, Rafaeli (1988) defined a model with three levels of interactivity of a message:

- **Non-interactive:** A one-directional message between a sender and a receiver or receivers, this represents the lowest level of responsiveness of the message. In terms of the Quality in Education system it can be related to information artifacts such as: reports, presentations, videos, audio, infographics, data, study guides, among many others.
- **Reactive:** A two-way directional message, in which a first message produces a second message related to the first one. This level can be related to forms, surveys and search engines.
- **Interactive:** Represents a continuous two-messaging from sender to receiver, in which the communication convey all the previous turns. It can be related to online forums, chat-platforms, and citizen support systems.

Consequently, interactive information artifacts convey significantly more complex interfaces compared to reactive and non-interactive ones. Additionally, with the implementation of online services, much of the HCI focus on interactivity of information artifacts has been directed towards understating the nature of their navigational, adaptive and customizable features (Deuze, 2003). Table 2, displays a set of studies related to information artifacts in Education, from where it is possible to observe the interaction spaces related to Quality in Education (regulatory, guidance and performance), the type of information flow (G2E, E2G,E2S, S2E, G2S and S2G) and level of interactivity (interactive, reactive and non-interactive).

Table 2. Usage Assessment of information artifacts related to Quality in Education

Article	Author/year	What was evaluated	Information flow/Interaction space	Type of Interactivity
Evaluating the Quality of Indian School Education boards' websites using multi criteria decision making models	Dani & Agrawal (2018)	36 homepages of national and state boards for secondary education in India.	Government to Educational Institutions/Regulatory	Interactive
Usability of mobile learning applications: a systematic literature review	Kumar & Mohite (2018)	Metanalysis of 23 publications conducting usability evaluation of mobile learning applications.	Educational Institutions to Students/ Performance	Interactive
Internet cognitive failure relevant to users' satisfaction with content and interface design to reflect continuance intention to use a government e-learning system	Hong et al. (2017)	Content and interface design of a government e-learning system in Taiwan to explore factors relevant to users' continuance intention to use the system	Government to Educational Institutions/Regulatory	Interactive
Analysis of usability of universities Web portals using the Prometheus tool - SIRIUS	Chamba-Eras et al (2017)	24 universities Web portals	Educational Institutions to Students/ Performance	Interactive
Development and Usability Test of an e-Learning Tool for Engineering Graduates to Develop Academic Writing in English: A Case Study	Lin , Liu & Wang T (2017)	Usability testing of an Engineering English Journal Paper Writing System	Students to Educational Institutions / Performance	Interactive
A study of the interface usability issues of mobile learning applications for smart phones from the users perspective	Ali, Alrasheedi, Ouda & Capretz (2015)	Two m-learning models were evaluated in terms of ease of use, user satisfaction, attractiveness, and learnability.	Students to Educational Institutions / Performance	Interactive
Usability design for video lectures	Chorianopoulos & Giannakos (2013)	A video lecturing system	Educational Institutions to Students/ Performance	Reactive

Assessing the accessibility and usability of Malaysia Higher Education Website	Abdul Aziz , Wan Mohd Isa & Nordin (2010)	120 samples of higher education institution websites from the online portal of the Ministry of Higher Education	Government to Students / Guidance	Interactive
Tale of two databases: The history of federally funded information systems for education and medicine	Weiner (2009)	Historical analysis of the usage success of two open access bibliographic databases related to Education and Medicine	Government to Students / Guidance	Reactive
Do computer science department websites meet the needs of students?	Palmer &Kent (2007)	49 Websites of computer departments at universities in North Carolina	Educational Institutions to Students/ Performance	Interactive
Evaluation of the interactivity of web-based learning systems: principles and process	Evans & Sabry (2003)	3 Web-based learning systems (WBLSs	Educational Institutions to Students/ Performance	Interactive
Website usability and content accessibility of the top USA universities	Zaphiris & Ellis (2001)	50 top fifty USA universities (US News 2001)	Government to Students/ Guidance	Interactive

As observed in Table 2, there is a significant research effort on evaluating different information artifacts related to education. There has been a notorious tendency to the evaluation in the performance space, involving highly interactive interfaces. This trend can be linked to aspects as the debate on the advantages and disadvantages of using Information and Communication technology in educational management, teaching and learning processes (Margaret, Uma, Tejonidhi & Neelakantappa 2018; Schulz, Isabwe & Reichert, 2015; Evans & Sabry, 2004); and how the physical classroom has been extended into new domains such as online, virtual and collaborative settings (Coetzee, Schmulian & Coetzee, 2017). However, different studies have related students learning needs with less innovative artifacts such as personal notes and lecture audio/video recordings of lectures (O´Brien & Verma,

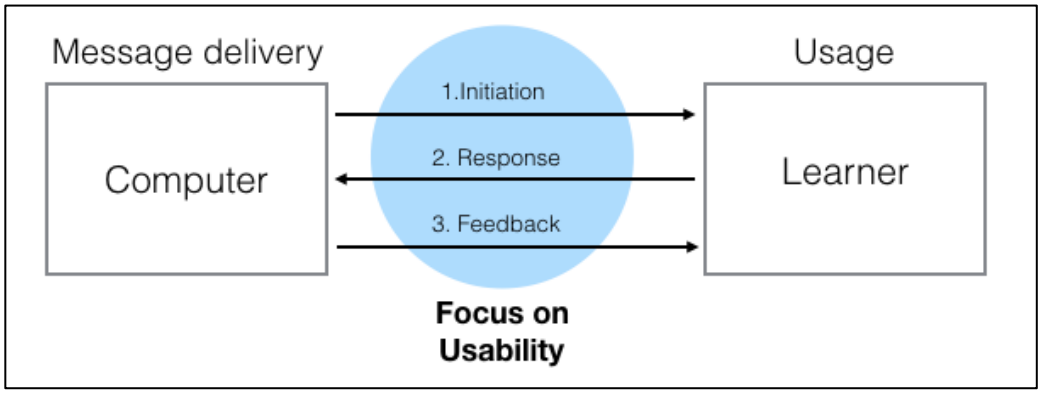
2018; Copley, 2007). Therefore, it is plausible to relate the complete learning experience of a given educational system to the use of multiple information artifacts, ranging from low to high levels of interactivity.

1.7 Towards Quality of Service: User Experience of low level interactivity artifacts

The effective usage of a system can be placed within the dimension of improvement of the Quality of Service, in which an overall match between user needs and information provider is achieved (Verdegem & Verleye, 2009). With regards to the information artifacts connected to the Quality in Education model context defined (Table 2) it is possible to observe that User Experience and Usability assessments need to advance in two complimentary dimensions: the system for delivering content and the content itself (Stromer-Galley, 2004). The Government of Chile has arranged a series of guidelines and projects in its e-government digital agenda to meet the goal of mass-use of online public services. In 2004, a set of national guidelines were created to ensure minimum usability standards for public websites and platforms (Comité de Ministros Desarrollo Digital, 2007). A great amount of these evaluation models (e.g., usability heuristics) can be related to the three-way model of interactivity (Rafaeli, 1988). In this framework an interaction is defined based on three sequential actions: (1) initiation; (2) response; (3) feedback**.** In the model, each action is related to a one-way flow of information between two agents. The first step (initiation) connects a first agent asking input from the second. In a second step (response) the second agent provides back an input. Finally, in a third step, feedback connects the first agent passing back information about the response. The three actions are correlated in terms that the response must be consistent with the

initiation, and the feedback must be in direct relation to the response. Evans & Sabry (2003) used this straightforward model to describe a computer-initiated interaction (see Figure 3).

Figure 6. A three-way model applied to computer-initiated interactivity



Computer-initiated interactions strongly relates to the practical use of information artifacts which can be assessed in terms of efficiency, efficacy and satisfaction within the constraints of the interaction, constructs that are core in Usability when defined as:

> *"The 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 (ISO,2010)*

From here it seems natural that most of the usage assessments in Table 2 are linked to technological and interactive artifacts assessed in the domain of Usability.

However, the previous model can be complimented with a user-initiated interaction in which the user defines the first input into the posterior flow of interactions. Dragunalescu (2002) defines a three way model that can be related to a user-initiated interaction with a website.

Here the interactions start with the user and its needs and/or requirements (step 1), which are interpreted by the information provider, who in response delivers a tangible/intangible product to the user (step 2), who finally has a reaction to the product (step 3). According to this model the "quality of the product" is built around the information provider taking into account both step 1 (user needs) and step 3 (user reactions) in the product delivery. Here the focus of the interaction is put on the information provider and how the process of understanding the user is managed.

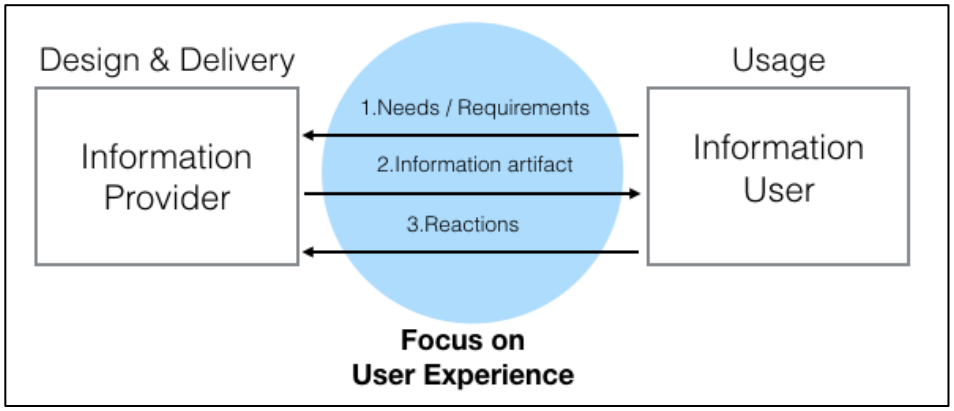
From a usage assessment perspective, a user-initiated interaction can be greatly referred to the User Experience definition:

"A person's perceptions and responses that result from the use and/or anticipated use of a product, system or service". (ISO, 2010)

Additionally, a user-inititated interaction model can integrate: a) Context-related factors such as social, spatial, temporal, infrastructural and task related issues (Wigelius and Väätäjä, 2009) b) Non-instrumental aspects of technology, such as user needs related to self-growth, increase in knowledge and skills (Hassenzahl, 2003).

In this thesis, the focus of the assessment of information artifacts has been related to a user-initiated interaction. This particular sort of interaction is depicted in Figure 4.

Figure 7. A three-way model relating Information provider and information user



In Figure 4, User Experience evaluation can provide significant input on which are the main needs and requirements that an information user has with regards to a task. User experience can also be part of the actual use of the information artifact in terms of understanding user perception while using the product. Finally, the reactions (or posterior perceptions) can also be assessed. This temporal assessment (pre, during and post experience of the product) relates to the main ideas expressed in the field and research agenda of User Experience assessment in which strong emphasis has been to take into account not only the system characteristics (functionality, usability, purpose), but also users internal states (needs, expectations, predisposition) and the context of use (Hassenzahl and Tractinsky, 2006)

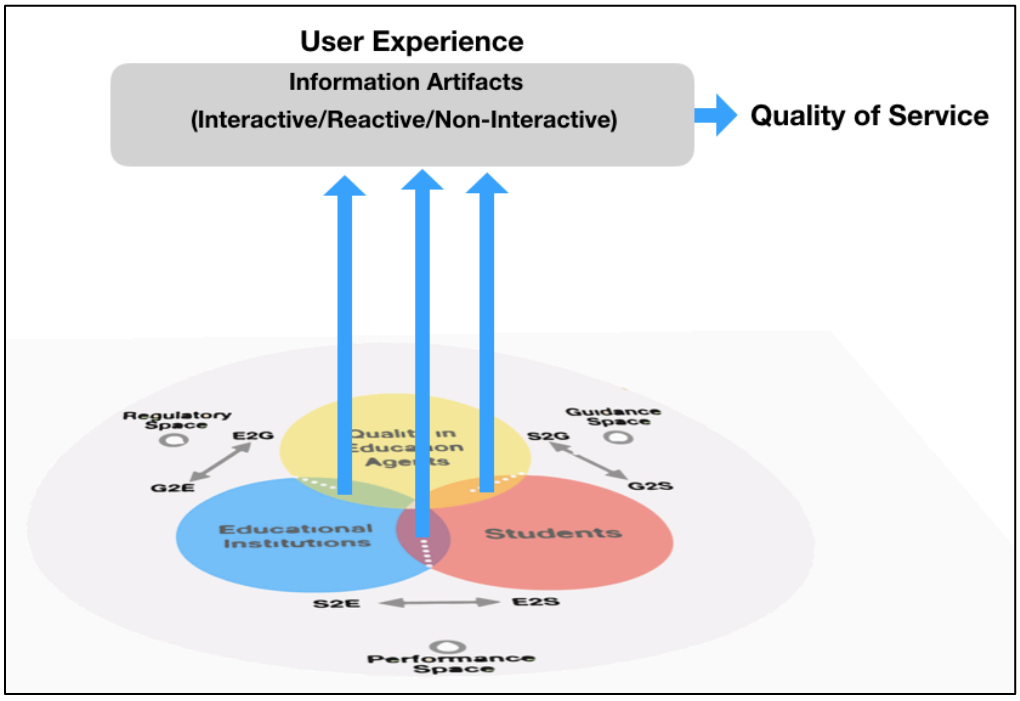
1.8 Problem statement

Despite a significant advancement of usage assessment with regards to information artifacts related to education either produced by government agencies or educational institutions, many types of products still remain low or absent in terms of usage evaluation. In consequence, the gap covered by this research has a scope on the low interactivity information artifacts. Figure 5 summarize the relationships between the

initial perspective of the Quality in Education System, and the challenge of achieving a balanced User Experience across all levels of interactivity to reach an ultimate Quality of Service goal.

User Experience assessment is related to the generation of assessment evidence in educational environments, not only to evaluate the quality of teacher service (performance level) but also how the school environment is holding accountable of government policy, helping students, parents and teachers to judge if learning goals has been reached, and what new goals and actions can be taken. Additionally, public agencies can also be hold accountable by the student population, enhancing their e-government accountability with regards to citizens (Al-Hujran et al, 2015)

Figure 8. User Experience with regards to the Quality in Education system



1.9 Thesis Methodology and Outline

The thesis process was based on an action research approach due to the need to integrate the experience gained in each stage into the next phase (or parallel phases) and to bring together the research team with other participants with the purpose to solve a problem and produce research results at the same time in a research context (Baskerville, 1999).

In this thesis, three different studies were conducted. One study was performed in terms of an Education Institution to Student information flow, where the information artifact was Learning Materials (Chapter 1). Additionally, two studies were performed in terms of the regulatory space mediating Government to Education Institutions (G2C) information flow (Chapter 3 and 4) with regards to the school system. This allowed to achieve amplitude over deepness of the research effort, being this a limitation that will be further explained in the conclusions section. In terms of the specific actors involved, in each study the following institutions participated:

A) Education Institution to Students (E2S): we worked with two large scale chilean universities. Both Pontificia Universidad Católica and Universidad Técnica Federico Santa María participated as context for initial experimentation with a User Experience assessment tool. Applied within an academical domain, where information artifacts provision was related to Learning Materials (i.e. non-interactive Information artifact) provision from instructors to students. Both Universities currently share a joint program called Engineering 2030, which has set to modernize and improve Chilean Engineering Education focusing on innovation.

B) Government to Educational Institutions (G2E): A significant section of the thesis project relates to an action research collaboration with the Chilean Quality in Education Agency (OECD, 2017). The interaction was focused on the Agency's Community Information Division, which designs, analyzes and implements information products (i.e., Agency website, social media sites, platforms, reports, among many others).

Figure 6 summarizes the context of research with the corresponding chapters of this thesis. Chapter 1 is related to the Educational Institution to Student (E2S) information flow. Chapter 2 and 3 are interlaced in terms of the Government to Educational Institution (G2E) information flow.

Figure 9. Chapters relation to the initial context of research

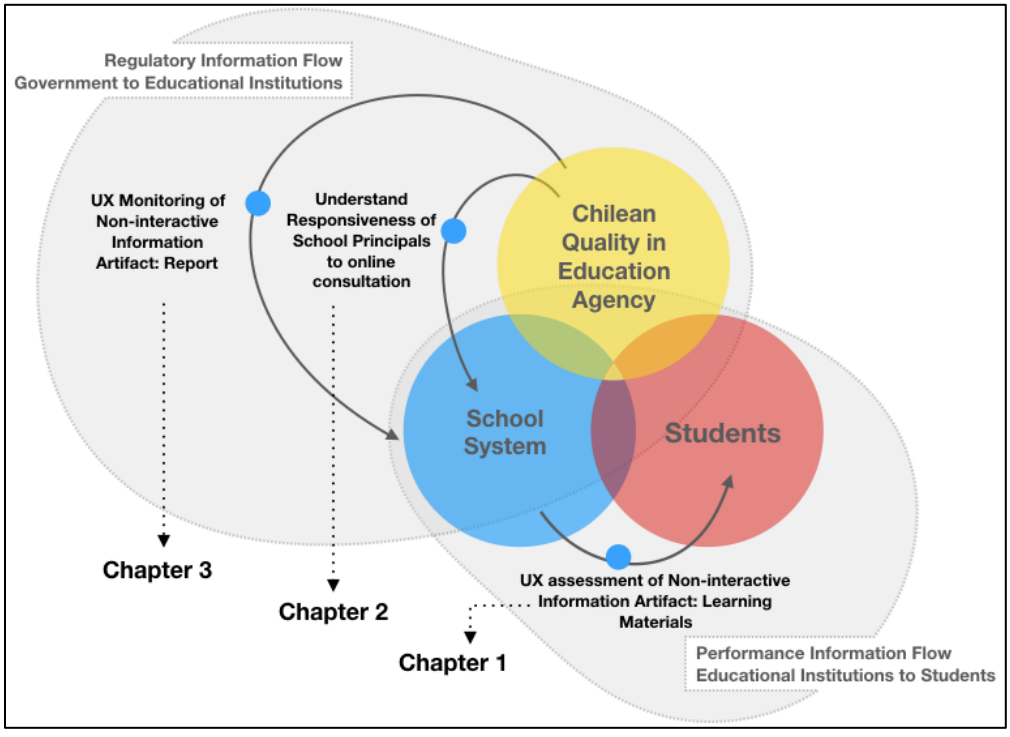


Table 3 summarize the relationship between the context showed in Figure 6 and the hypotheses, research questions and results obtained in each of the three studies.

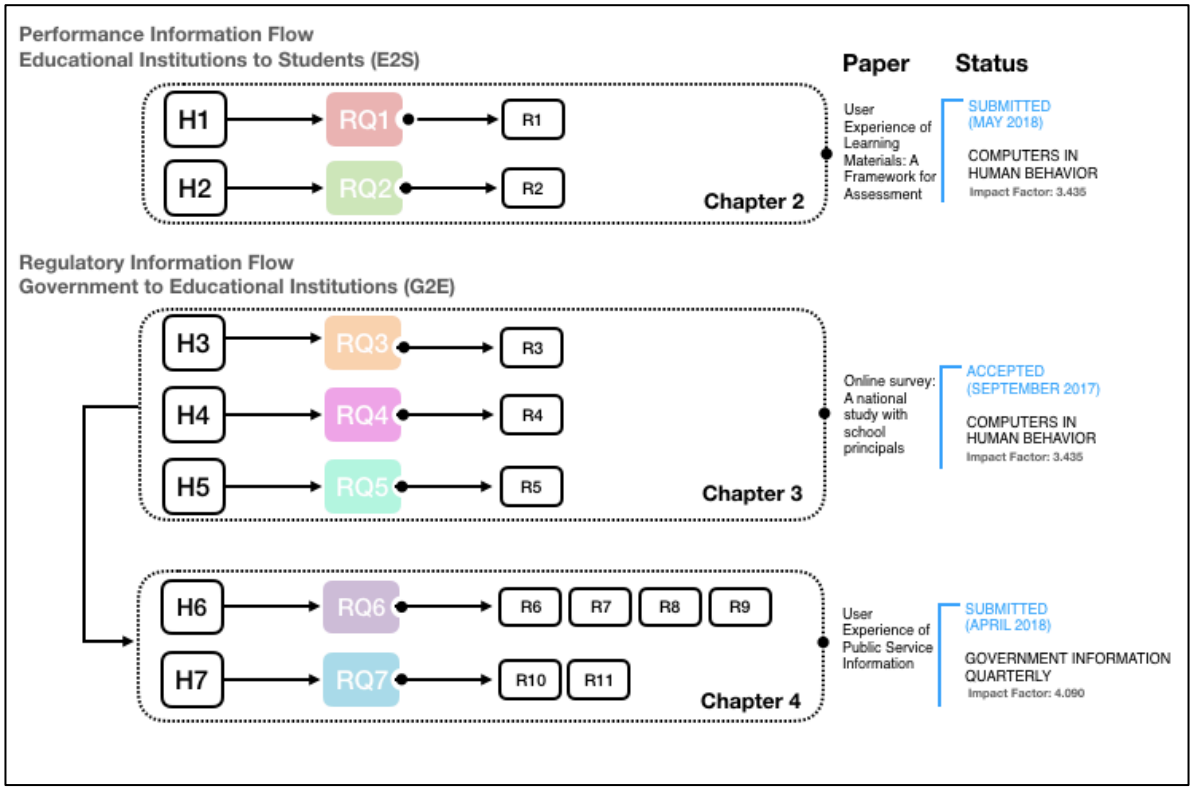
Table 3. Methodology and its relation to the thesis outline

Information flow/Level	Hypothesis	Research Question	Chapter/Paper	Results
3. Educational Institutions to Students (E2S) / Performance	H1: A survey tool which allows information providers to monitor key aspects of User Experience should provide easy to interpret results	RQ1: How can educational institutions asses the User Experience of the low interactivity information artifacts delivered in order to meet their learning objectives?	Chapter 2 Paper: User Experience of Learning Materials: A Framework for Assessment	R1: An User Experience assessment, based on a five-question survey, that is easy to implement and low resource consuming in terms of time for answering and data interpretation
3. Educational Institutions to Students (E2S) / Performance	H2: User Experience assessments should allow to make inferences about specific user needs in the context of study	RQ2: What can educational institutions learn by assessing the User Experience of their learning materials?	Chapter 2 Paper: User Experience of Learning Materials: A Framework for Assessment	R2: Usage of Learning Materials is mostly driven by students need to perform well according to course requirements, rather than applying knowledge to professional context, which should be their main objective
1. Government to Educational Institutions (G2E) / Regulatory	H3: An Online survey will have better response rate if its sent according to respondents time availability	RQ3: Is there a better time in the week to send out online surveys to educational institutions representative?	Chapter 3 Paper: Online survey: A national study with school principals	R3: There is no better moment in the week to send out an online survey
1. Government to Educational Institutions (G2E) / Regulatory	H4: Reminder emails promote better response rates in online surveying	RQ4: What is the effect of sending reminder emails over response rates and response times?	Chapter 3 Paper: Online survey: A national study with school principals	R4: There were a significant effect of reminder email over response rate to the survey sent by email.
1. Government to Educational Institutions (G2E) / Regulatory	H5: An email embedded survey should be easier and faster to answer since user makes less clicks to reach the survey	RQ5: How does a survey embedded in an email compare with a web-based survey in terms of response rate and response time?	Chapter 3 Paper: Online survey: A national study with school principals	R5: No significant effect over response rate and response time when embedding a survey in email, as opposed to sending a link
1. Government to Educational Institutions (G2E) / Regulatory	H6: Classification of information artifacts can help Public Services understand the stream of	RQ6: How can Public Service Information materials be classified (or grouped) in terms	Chapter 4 Paper: User Experience of Public Service Information	R6: A model for categorizing Public Service Information Materials based on User Experience and

	products delivered to Citizens	of User Experience?		Information Quality frameworks
1. Government to Educational Institutions (G2E) / Regulatory			Chapter 4 Paper: User Experience of Public Service Information	R7: By categorizing the information products, a Public Agency can have more visibility of the information artifacts delivered
1. Government to Educational Institutions (G2E) / Regulatory		RQ7: Can organization relate its system of information products to its main goal?	Chapter 4 Paper: User Experience of Public Service Information	R8: By categorizing all the information artifacts with regards to user needs, a Public Agency can understand it is reaching its core mission in terms of information provision.
1. Government to Educational Institutions (G2E) / Regulatory			Chapter 4 Paper: User Experience of Public Service Information	R9: Classification establishes an initial 'baseline' assessment. Contrasting this baseline with the results of the user assessment will help organizations better understand the communication gap between the information provider (public service) and the users (citizens).
1. Government to Educational Institutions (G2E) / Regulatory	H7: A UX monitoring process over time may allow understating the reasons behind effective or ineffective usage of information artifacts	RQ7: How can the User Experience of Public Service Information be monitored over time in order to inform design decisions?	Chapter 4 Paper: User Experience of Public Service Information	R10: Definition of a model for monitoring User Experience of a specific product over time allowed for a better understanding of the users' attitudes towards e-participation and the use of public information
1. Government to Educational Institutions (G2E) / Regulatory			Chapter 4 Paper: User Experience of Public Service Information	R11: Management and Resources are the team's main concerns when it comes to implementing user-centered processes within the organization. This is linked to the fact that continuous testing and assessment of information requires higher levels of resources and support from decision-makers

Additionally, Figure 7 summarizes how hypotheses, research questions and results relate to each other and the current status of publishing efforts of the obtained results.

Figure 10. Summary of Methodology and current status of results



Chapter 2 is a complimentary study with regards to the other two; it brings perspective into User Experience assessment at performance levels, one of the three contextual levels defined in Figure 2. The results from chapter 3 oriented the aspects of the study described in chapter 4, particularly understanding that there was no ideal timeslot in the week to send out online surveys to school principals (results 3), allowed to perform the third study with independence from this variable. However, result 4 (significant effect over response time of reminder emails), influenced the third study since this was applied to the process. With regards to each chapter, it is possible to detail:

a) Chapter 2: User Experience of Learning Materials: A framework for Assessment, was submitted in May 2018 to the journal Computers in Human Behavior (impact factor: 3.435).

Previously, initial results were presented in the bi-annual Conference of EARLI-European Association for Research in Learning and Instruction in Tampere, Finland (September, 2017). Highlights of the chapter:

- Learning Materials still play a significant role in the student learning experience in Higher Education
- The User Experience (UX) of Learning Materials is often not assessed by instructors at Higher Education institutions
- The use of short UX surveys in Higher Education can provide a powerful insight into the prevailing pedagogical policy and practice at an institution

b) Chapter 3: Online Survey: A national study with school principals was accepted in September in 2017 in the journal Computers in Human Behavior. Highlights of the chapter:

- Government consultation processes use on-line surveys extensively
- On-line surveys may represent information overload to final recipients
- Reminder emails allows increasing response rate to an on-line survey
- Web-linked survey display better response rate than an email embedded one
- School principals response rate and response time are context dependent

c) Chapter 4: User Experience of Public Sector Information: Was submitted to the journal Government Information Quarterly (impact factor: 4.090). Highlights of the chapter are:

- Provides an insight into how government organizations can improve the User Experience of their Public Service Information (PSI)
- Develops a model for categorizing Public Service Information materials
- Characterizes a nationwide study of User Experience

2. USER EXPERIENCE OF LEARNING MATERIALS: A FRAMEWORK FOR ASSESSMENT

2.1 Introduction

Instructional material often remains fixed, unvaried and static, adaptive to individual needs in only minor ways, if at all. Students are expected to fit into the system and to cope as best they can"

(McLoughlin, 1999)

Despite the development of new forms of teaching and learning, traditional instructional design still plays a significant role in the student experience in higher education (Olsson, 2017; French & Kennedy, 2016). While the newer methods include open education, online, mobile, collaborative and active learning, higher education courses are often based on lecture-style classes, with a heavy focus on content. Given this scenario, the developers of instructional materials often face the challenge of creating student-centered solutions and learning experiences (Antonenko, Dawson and Sahay, 2016).

Learning Materials are information artifacts that are shaped by the cultural structure that underpins the instructional design (Henderson, 1996). Mehisto (2012) defines learning materials as *"information and knowledge that are represented in a variety of media and formats, and that support the achievement of intended learning outcomes".* Traditional Learning Materials, such as study guides, presentations and reports, often only allow for one-way communication from material to user (Hoidn, 2016). However, web-based Learning

Materials may allow for more complex levels of interaction (Jamal, Nasir, Mohamad et al., 2015; Zaharias & Mehlenbacher, 2012).

Most of the Learning Materials provided by instructors are designed by themselves (Jääskelä, Häkkinen & Rasku-Puttonen, 2017; Kali, McKenney & Sagy 2015). Teacher-led materials design has been extensively covered in the literature. Kali (2015) highlighted the need to research the quality of the information artifacts that are created through teacher-designed materials, as well as how these are implemented and the impact they have on learning outcomes. Furthermore, research has also focused on issues such as the scarcity of time and limited support for the design of activities (Kirschner, 2015), as well as limited design skills (Kali, McKenney & Sagy 2015) and the need to support design efforts with new tools for inquiry (Boschman et al., 2016). When creating new learning materials, researchers have used student feedback to guide the design and/or re-design process. This feedback has focused on dimensions such as access, learning outcomes, support, technology acceptance and stereotypes (Li & Tsai, 2017; Beege, Schneider, Nebel et al., 2017). However, less attention has been directed towards involving the User as an actor of the learning materials and considering their need to use them within an instructional environment, which probably influences their use (Junus, Santoso, Yugo, Isal et al., 2015).

In this sense, our first research question asks: *How can educators assess the Student Experience of Learning Materials that are created in order to meet their learning objectives?*

As learning in higher education is mediated by a complex array of Learning Materials, both digital and non-digital, it has become increasingly important for institutions to understand their use from the students' perspective. It is also important to understand where these materials can

be placed within the continuum of the learning experience itself (Antonenko et al., 2017). In order to improve learning itself, it is essential that we understand how the production or edition of these materials relates to an institution's strategies, as well as its pedagogical policies and practices (French and Kennedy, 2017). In this sense, our second research question asks: *What can institutions learn by assessing the User Experience of their learning materials?*

The aim of this study is to provide evidence that instructors and institutions can benefit from assessing the User Experience of their Learning Materials. This is because such an assessment can provide data for explaining the use of certain artifacts with contextual evidence, as opposed to being removed from the continuum of the learning experience.

2.2 Theoretical Framework

2.2.1 User evaluation in Education

User experience has been widely studied within the areas of Human Computer Interaction and Human Factors Engineering (Buie & Murray, 2012). Models and methods for measuring usage are mostly related to Usability and User Experience. Both constructs have become an established point of reference in the process of technology development. This is fundamentally linked to the strategy of User-Centered Design (Hassenzahl and Tractinsky, 2006).

Usability has a long been used as a methodological reference during the testing and implementation phases of research in the field of education (Schneider & Blikstein, 2018; Squires & Preece, 1996). This is especially true when it comes to developing information

artifacts. The literature reveals that Usability has mostly been used as a tool for measuring certain aspects within the domains of efficacy, efficiency and/or satisfaction. On the other hand, User Experience involves a more general idea of the interaction with the information artifacts that are used for learning. Furthermore, User Experience also looks to consider the influence of the thoughts, feelings, and perceptions that are derived from previous interactions (Tullis & Albert, 2013).

The need to capture students' perceptions of an information artifact (digital or otherwise) that is geared towards learning has become critical. However, while necessary, the technical side of these assessments (such as evaluating the number of errors, time to task, etc.), may be incomplete when it comes to understanding their use in complex pedagogical contexts (Lee, Baek & Han, 2018). Therefore, some authors have adapted specific concepts from HCI with the idea of including "pedagogical goals" in their evaluation models. The work by Nokelainen (2006) connecting the evaluation of a Learning Material to specific learning goals is a well-cited example of this trend. More recently, it is possible to observe a larger stream of research in which well-known concepts from the Human Computer Interaction field are applied to educational artifacts (see Table 4).

Table 4. Usage studies of information artifacts in education

Nº	Title	Author/Year	Description	Findings or Impact
1	An empirical assessment of pedagogical usability criteria for digital learning material with	Nokelainen (2006)	Defines that each individual learning material has its own user interface, the usability of which can be evaluated, as well as a definable learning goal.	Develops a model that includes: 1. Learner control, 2. Learner activity, 3. Cooperative/Collaborative learning, 4. Goal

	elementary school students			orientation, 5. Applicability, 6. Added value, 7. Motivation, 8. Valuation of previous knowledge, 9. Flexibility and 10. Feedback
2	Examining Mathematical Task and Pedagogical Usability of Web Contents Authored by Prospective Mathematics Teachers	Akayure & Apawu (2015)	Application of a Mathematical Task Usability Scale and Pedagogical Usability Rubrics to assess modules designed by 172 prospective mathematics teachers.	Concludes that the web contents produced by the participants through learning web technology-by-design activities have significant pedagogical value
3	Investigating Technical and Pedagogical Usability Issues of Collaborative Learning with Wikis	Hadjerrouit (2012)	Implementation of a case study to examine the technical and pedagogical benefits and challenges of using wikis to support collaborative learning.	Was able to report on dimensions associated to Pedagogical Usability and contrast wikis with other common technologies for collaboration.
4	Usability Evaluation of an Augmented Reality System for Teaching Euclidean Vectors	Martín-González, Chi-Poot & Uc-Cetina (2016)	Application of a System Usability Scale to an Augmented Reality System.	The result of the system usability scale revealed the system's level of usability and learnability.
5	Usability Evaluation of the Student-Centered e-Learning Environment (SNA)	Junus et al. (2015)	Usability testing of a student-centered system (SCele) in order to propose a set of recommendations.	Problems with usability in the Motivation to Learn factor reveal that students have a higher motivation to learn in SCeLE if there

				is positive encouragement from the lecturer and/or academic incentives.
6	Assessing the User Experience of E-Books in Academic Libraries	Zhang, Niu & Promann (2017)	Testing User Experience when searching for information in the context of electronic books in libraries.	User tests found that participants tended to use the default keyword search and browse the search results. Experience levels with e-books and features of e-book platforms influenced how users searched for information in e-books.
7	Measuring the User Experience of the Student-Centered e-Learning Environment	Santoso et al. (2016)	Adaptation of a User Experience Questionnaire (UEQ) and evaluation of a learning management system (N= 213 students).	Most of the lecturers use discussion forums in their courses to encourage students to participate in active learning.
8	A Comparison of Two Online Learning Systems	Nichols (2016)	Uses views on User Experience to compare student outcomes, high-level course evaluations, and student perceptions of the two approaches: Moodle (print and textbook) and iQualify (online-only).	Findings indicate that while students tend to prefer printed materials, actual withdrawal and pass rates are not affected by an online-only approach.

From Table 4, it is possible to observe the following conditions:

- A significant number of evaluations focus on understanding the deployment of systems that are highly interactive. Within these systems, the user interaction during the learning process is related to a complex flux of messages and decision-making actions.
- These evaluations rely mostly on the tools and methods that are provided by the field of Usability Studies and therefore end up providing recommendations on how to improve the solution in terms of Efficiency, Efficacy, Satisfaction, Learnability and Error Tolerance. They do not necessarily relate to the system's wider pedagogical context.
- There has been a shift away from Usability methods and towards User Experience evaluations. This change in perspective most probably relates to the need to observe a continuum of interactions that students experience on a daily basis, in which different formal and informal instances and systems are interwoven in terms of knowledge creation (Sinha, 2012).
- Evaluations tend to be timely, thus requiring the use of significant resources for applying the study and analyzing the results.

In this sense, as an emerging field, User Experience may be appropriate for assessing information artifacts. This is because of the following aspects:

- Context-related factors: A range of contextual factors affect User Experience and are therefore pertinent to the design and evaluation of systems. For example,

Wigelius and Väätäjä (2009) discuss five dimensions of context that affect user experience: 1) social, 2) spatial, 3) temporal, 4) infrastructural, and 5) task context. In terms of the educational context, different authors have highlighted the need to understand contextual factors when implementing technology in the classroom. Some emphasize teacher-oriented dimensions, such as teacher ICT-training, collaboration among teachers and teaching concepts that influence ICT-use (Gil-Flores et al., 2018). Other authors focus on student-level factors, such as performance expectancy, fun or pleasure, habits and trust (El-Masri & Tarhini, 2017).

- Non-instrumental aspects of technology: As stated by Gaver and Martin (2000), an assessment of the User Experience of technological artifacts should go beyond the functional requirements. It should also address aspects such as surprise, fun, or intimacy. Hassenzahl (2003) claimed that the future of interactive products should be related to their impact on aspects such as personal growth, self-expression and an increase in knowledge and skills. In education, this may be linked to aspects such as gaining self-confidence while using a solution, or perceiving certain Learning Materials as being more trustworthy than others, depending on its source or creator.
- Judgement about the experience itself: Since User Experience can be conceptualized as a stream of perceptions (Ariely and Carmon, 2003), past experience has the ability to affect current experience. In the assessment of Learning Materials in educational settings, this can be related to the overall performance of students on a course. It may therefore be important to test the User Experience of Learning Materials without the bias of test results. This is because a positive or negative experience on a test may

influence the students' perception when subsequently assessing information artifacts that were used to prepare for said test.

2.2.2 Student perception of Learning Materials

Learning Materials are information artifacts that complement the core method of instruction. In the current context of educational technology development, a significant number of digital Learning Materials found in online repositories have changed from being static to flexible information sources. In this sense, users can now reformulate and change the information according to their own needs (Ungerer, 2016; Schoonenboom, Sligte & Kliphuis, 2009). Furthermore, with the development of web-based education, courses now in Higher Education now require considerable interaction between educators and students when using these conventional learning objects (O´Flaherty & Phillips, 2015).

Assessing how useful and user-friendly these items are therefore becomes a primary objective when it comes to supporting their effective use. Furthermore, assessing the User Experience is also critical to the instructional design process. This is because it may build the instructor's design expertise, given that most instructors are novice designers. *(Huizinga, 2014).* Table 5 shows the relevant literature on the assessment of Learning Materials from a user perspective.

Table 5. Student assessment of Learning Materials

Nº	Title	Author/Year	Description	Findings or Impact
1	Students' Perception of Using Online Language Learning Materials	Zamari (2012)	Survey of 97 students exploring reasons behind using online materials, ways of searching, problems encountered and perception of the quality.	Less than a half of the students would not search or use online learning activities if they were not

				part of the course requirements.
2	Visual design guidelines for improving learning from dynamic and interactive digital text	Jin (2013)	Two design guidelines for structure (for enhancing comprehension of a text's structure) and two design guidelines for selective attention (for focusing the learners' attention on the essential content) were developed.	Both the structure and selective-attention design guidelines had a positive influence on comprehension of the text's structure and the essential content, as well as on the usability of the digital text.
3	Exploring the role of content knowledge in teacher design conversations	Boschmann et al. (2016)	Investigated the role of content knowledge in conversations between kindergarten teachers during the collaborative design of learning materials for technology-enhanced learning	Found that by explaining content knowledge and pedagogical content knowledge, teachers set goals and deliberated on which strategies and activities would be most appropriate for their students.
4	Designing for Educational Technology to Enhance the Experience of Learners in Distance Education: How Open Educational Resources, Learning Design and Moocs Are Influencing Learning	Scanlon, McAndrew and O´Shea (2015)	This research explores several factors that are linked to the outcomes of instruction: the often-unpredictable motivations of learners, the trajectories they take through courses, and the indicators for success in formal and informal learning, in terms of both pedagogy and technology.	Suggests that the greatest benefit to learning will occur when an integrated approach to design, technology and pedagogy is adopted.

5	A Service Based Adaptive U-Learning System Using UX	Young Jeong & Yi (2014)	Focuses on providing the learning material and processes of courses by learning units using the services in a ubiquitous computing environment.	Analyzed the user's data and their characteristics in accordance with their user experience, subsequently applied the learning process to fit on their learning performance and preferences.

From Table 5 it is possible to observe the following aspects relating to how Learning Materials are being assessed from a student perspective:

- Students' use of Learning Materials is mostly linked to their need for academic achievement.
- Desirable learning outcomes are related to the effective integration of the pedagogy, technology and design of the learning experience.
- When instructors reflect on the content that is to be included in information artifacts it leads to improved learning strategies for their students.
- Learning Materials are mostly assessed in terms of what they allow students to do in a particular context. There is a lack of methodological tools to understand the impact of Learning Materials in terms of the students' broader learning context.

In a global schema in which Higher Education institutions need to guarantee the access, equity and quality of their learning processes, the need to lean on context-aware frameworks

for assessment has become critical. Therefore, measuring the Student Experience of Learning Materials can relate directly to how institutions understand and ensure the quality of their pedagogical policies and practices. This in turn can help them create the best possible learning experience.

2.3 Method

This study adopted an Action Research approach, which was applied to the assessment of an information artifact in several iterations over a period of time (Baskerville, 1999). The aim of this was to meet the general goal of the study, which is defined as: *"To develop a User Experience assessment framework for evaluating Higher Education Learning Materials"*. An Action Research approach was adopted as it allowed the team to adapt their research based on the knowledge and actions that emerged at each stage of the study.

2.3.1 Stages of the study

The study was composed of the following stages, as described in Figure 8:

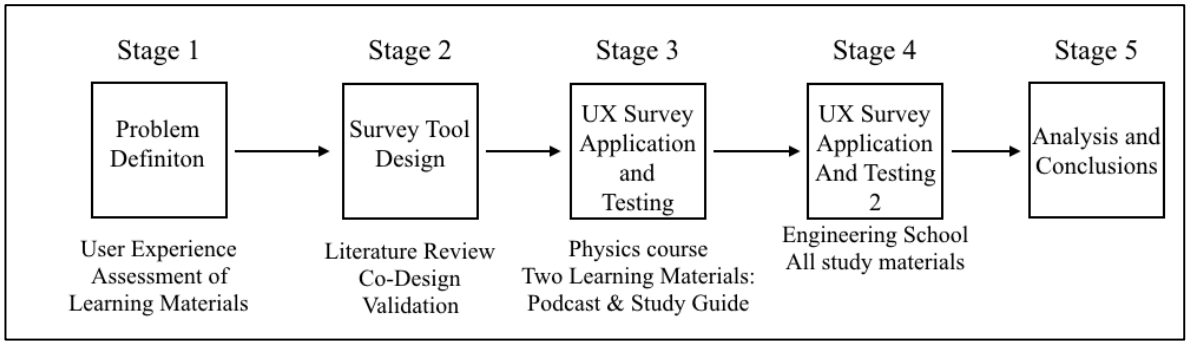
- Stage 1: Problem definition: The need to assess Learning Materials was discussed with students from the Student Council at the School of Engineering (at Institution B[1] in Chile) and with a body of instructors from the Computer Science Department (at Institution B in Chile) and Physics Department (at Institution A in Chile). This was part of an ongoing effort by both institutions to join efforts and innovate within engineering education.
- Stage 2: Survey Tool Design: An assessment framework and tool was designed with the aim of capturing student perceptions and experience with Learning Materials.

[1] For blind submission purposes, the names of both universities have been omitted.

This tool was validated with instructors and students from the Student Council at the School of Engineering. The tool and procedure were approved by the Institutional Review Board. The survey itself was created and stored in a SurveyMonkey account.

- Stage 3: This stage looked to answer research question 1: *How can educators assess the Student Experience of Learning Materials that are created in order to meet their learning objectives?* The research team worked with two physics professors who lead a General Physics course (Electromagnetism) for engineering students. Enrollment in this course at Institution A was approximately 300 students. A survey, distributed via the course website (based on Moodle), was applied twice in one semester. For the first survey, the students had recently used a short podcast explaining a concept. For the second survey, the students had recently used a study guide. In this sense, the survey was tested to see whether it fulfilled its goal of assessing the students' perception of different Learning Materials.
- Stage 4: This stage looked to answer research question 2: *What can institutions learn by assessing the User Experience of their learning materials?* The survey was adjusted based on feedback from members of the Student Council within the School of Engineering at Institution B, with approximately 4,500 undergraduate students enrolled in 22 majors. These adjustments were geared towards correcting the wording of the questions. The survey was sent out as a link via Facebook and Twitter.
- Stage 5: Data analysis was performed in order to understand whether there were any differences in the experience of: a) Male and Female students and b) First Cycle students (1st, 2nd and 3rd year) and Second Cycle students (4th, 5th and 6th year).

Figure 11. Stages of Research



2.3.2 Participants

Participants in the study were engineering and science majors at two higher education institutions in Chile.

Table 6. Sample of study

		Sample Size	Male	Female	First Cycle	Last Cycle
Institution A	Survey 1	184	140	44	100	84
	Survey 2	91	65	26	41	50
Institution B	General Survey	382	257	125	226	156
	TOTAL	657	462	195	367	290

In the case of Institution A, the sample was representative but not randomized. This is because the survey was sent internally to all students in the course. In the case of Institution B, the sample was both representative and randomized.

At Institution B, it was possible to see which topics the survey responses were referring to. Table 7 shows the ten courses with the highest number of responses.

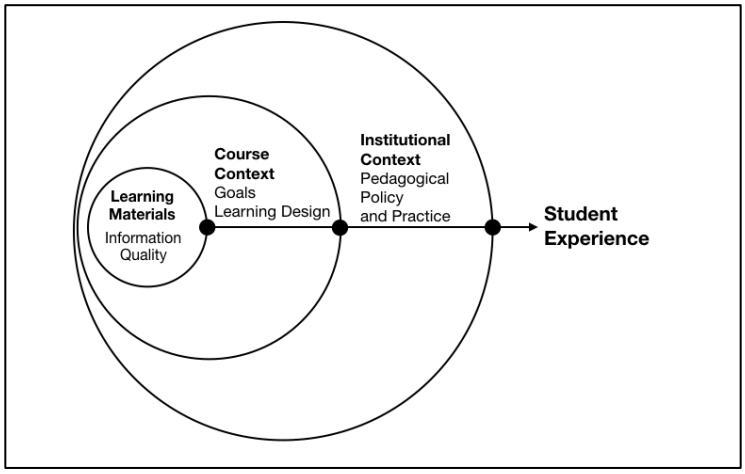
Table 7. Main topics of the survey responses

Key Courses and/or Topics	Number of responses
Chemistry	24
Statics and Dynamics	16
Estochastic Models	12
Finances	10
Physics	9
Thermodynamics	9
Linear Algebra	9
Optimization	9
Statistics	7
Fluid Mechanics	5
TOTAL	110

2.3.3 Development of Assessment Framework

The assessment framework for this study is based on expanding on the idea that Learning Materials are complimentary artifacts in the context of a course (Mehisto, 2012). In turn, these courses form part of the pedagogical policy and practice that is defined by an institution. As shown in Figure 9, the "experience" of a Learning Material should be connected to the information itself. This is because the Learning Materials provide an information artifact that supports the goal of the information in a broader context. This context can range from the course requirements to how the course relates to the institutional framework of pedagogical policy and practice.

Figure 12. Assessment framework



Based on this framework, a short survey was developed based on a series of dimensions taken from different fields of study: Information Quality, User Experience, Usability and Pedagogical Usability. The aim of this survey was to capture the students' general experience of a particular Learning Material.

A five-question survey was defined as the best instrument for understanding the student experience of Learning Materials (Stages 3 and 4, Figure 8). This instrument was then validated with four university instructors and six members of the Student Council at the School of Engineering. The specific surveys used in Stages 3 and 4 can be found in Appendix A and B, respectively. Table 8 summarizes the information regarding the design of the assessment tool.

Table 8. Survey structure

Field of Study	Dimension	Definition	Question	Answer options
Information Quality	Amount of Information	Perception of the volume of content that	1. The Learning Material was:	- Too short - Adequate in length

(Wang & Strong ,1996)		the information artifact contains and that needs to be processed by the user.		- Too long
User Experience *(ISO FDis, 2009)*	Learning Goal Context	Perception of which specific aspect of instruction the Learning Materials are related to.	2. Which purpose did you feel the study material served?	- Learning how to apply knowledge to a professional context - Preparing for a test - Understanding conceptual aspects of the course - Don't know
Usability (*ISO FDis, 2009)*	Ease of Understanding	Perception of how the design of the content relates to the students' prior skills and knowledge.	3. The study material was:	- Easy to understand - Fairly understandable - Hard to understand
Pedagogical Usability (Nokelainen, 2006)	Usefulness	Perception of how helpful the Learning Materials have been for the students.	4. The academic help provided by the study materials was:	- Very useful - Adequate - Fairly useful
Pedagogical Usability (Nokelainen, 2006)	Relevancy	Perception of how the Learning Materials relate to the students' broader learning needs.	5.The contents of the study material were:	- Pertinent to my learning needs - Somewhat related to my learning needs - Unrelated to my learning needs

The following changes were made between stages 3 and 4, based on feedback from the students and instructors:

- At the beginning of the survey, students were asked to type in the name or topic of the course that their assessment of the Learning Materials referred to in the survey. Additionally, they had to specify the semester in which they took the course in the following question. The aim of this was to be able to identify potentially critical courses.
- One of the possible answers to question 2 was changed. While in stage 3, the third option was "Both of the above", in stage 4 it was changed to "Understanding conceptual aspects of the course". This change was made in order to add a dimension which seemed relevant to Learning Materials that were focused on delivering base knowledge.
- The wording of the artifact that was assessed (Podcast or Study Guide) was changed to "Learning Materials" in the header of each question so as to add generality.

2.3.4 Data Analysis

The survey responses were analyzed in terms of the proportion of responses for each of the alternatives. Three specific analyses were performed in the order to understand key differences within the sample population:

- Stage 3: Podcast versus Study Guide: We report on the differences between the two types of Learning Materials. Firstly, a Podcast represents a media-rich artifact geared towards explaining concepts. A Study Guide, on the other hand, includes fewer media

features (only text and figures, as a black and white photocopy) and is geared towards developing reasoning skills through practice.

- Stage 4:

  a) Gender Differences: We report on any possible differences between males and females with regards to any of the dimensions included in the study.

  b): Instructional Cycle Differences: Respondents were grouped as First Cycle Students (undergraduates in the 1st, 2nd or 3rd year of their program) and Second Cycle Students (undergraduates in the 4th, 5th or 6th year of their program). This was done in order to look for differences in the perception of students who may still be adapting to Higher Education and those who should already have adapted. In this sense, students in the Second Cycle may have different course requirements and therefore have different needs when it comes to the information artifacts they use.

A two-tailed t-test was performed using the XLSTAT plugin for Excel in order to compare the two population proportions. This was done for each pair of proportions within the study. The level of significance was set at alpha=0.05.

2.4 Results

2.4.1 Research Question 1

With regards to the first research question (*How can educators assess the Student Experience of Learning Materials that are created in order to meet their learning objectives?)*, Table 9 summarizes the results from the first part of this study (Stage 3 of the methodology), in which a survey was conducted in order to compare two different Learning Materials.

Table 9. Student Experience of Podcast vs. Study Guide

		Amount of Information				
		Short	Adequate	Extensive		Total
PODCAST	Count	25	140	19		184
	% of total	13,6	76,1	10,3		100,0
STUDY GUIDE	Count	4	72	15		91
	% of total	4,4	79,1	16,5		100,0
	Z-statistic	2,52	-0,42	9,03		
	p-value	**0,006**	0,68	**< 0,0001**		
		Learning Goal				
		Apply knowledge to professional context	Prepare myself for test taking	Previous both	Don´t know	Total
PODCAST	Count	9	111	38	26	184
	% of total	4,9	60,3	20,7	14,1	100,0
STUDY GUIDE	Count	1	73	8	9	91
	% of total	1,1	80,2	8,8	9,9	100,0
	Z-statistic	1,54	-3,46	2,62	0,845	
	p-value	0,12	**0,001**	**0,009**	0,40	
		Usefulness				
		Little Useful	Adequate	Very Useful		Total
PODCAST	Count	16	122	46		184
	% of total	8,7	66,3	25,0		100,0
STUDY GUIDE	Count	9	48	34		91
	% of total	9,9	52,7	37,4		100,0
	Z-statistic	-0,10	2,03	-1,93		
	p-value	0,92	0,04	0,05		
		Ease of Understanding				
		Hard	Adequate	Easy		Total
PODCAST	Count	9	71	104		184
	% of total	4,9	38,6	56,5		100,0
STUDY GUIDE	Count	12	63	16		91
	% of total	13,2	69,2	17,6		100,0
	Z-statistic	-1,92	-4,95	7,04		
	p-value	0,03	**< 0,0001**	**< 0,0001**		
		Relevancy with learning needs				
		Unlinked	Somewhat	Pertinent		Total
PODCAST	Count	5	63	116		184
	% of total	2,7	34,2	63,0		100,0
STUDY GUIDE	Count	2	18	71		91
	% of total	2,2	19,8	78,0		100,0
	Z-statistic	0,000	2,50	-2,52		
	p-value	1,00	0,01	0,01		

From Table 9, we can make the following observations:

- **Amount of Information:** The proportion of students who considered the Podcast to be short was significantly higher (13.6%) than those who considered the Study Guide to be short (4.4%) ($z=2.52$, $p=0.006$). This makes sense given the dynamic interaction with the podcast format, in which content was read aloud and complemented with more visual information (graphs, diagrams, etc.). In contrast, the percentage of students who found the Study Guide to be long (16.5%) was significantly higher than those who found the Podcast to be long (10.3%) ($z=9.03$, $p<0.0001$).
- **Learning Goal:** The percentage of students who felt that the Learning Material was aimed at preparing for test-taking was significantly higher for the Study Guide (80.2%) than the Podcast (60.3%) ($z=-3.46$, $p<0.0001$). This is consistent with the instructor's goal of preparing Study Guides to prepare students before a test. In this sense, Study Guides can be used to help students translate conceptual knowledge into actual operations. Furthermore, the percentage of students who felt the Learning Material had an impact on both professional knowledge *and* test-taking was significantly higher for the Podcast (20.7%) than the Study Guide (8.8%) ($z=-2.62$ $p=0.009$). This result is difficult to interpret. However, we believe that the students saw the Podcast as being more conceptually-oriented, helping them to understand how the content can be applied in future professional environments.
- **Usefulness:** There were no significant differences in how the students assessed this dimension for the Podcast and the Study Guide. However, the percentage of students who considered the Learning Material to be "adequate" was higher for the Podcast (66.3%) than the Study Guide (52.7%), although this difference was not significant.

In contrast, a higher proportion of students considered the Study Guide to be "very useful" (37.4%), in comparison to the Podcast (25%). Again, this difference was not significant.

- **Ease of understanding:** The percentage of students who considered the Podcast to be "easy" to understand (56.5%) was significantly higher than for the Study Guide (36%) **(**$z=-7.04$, $p<0.0001$). This is consistent with the aim of making Podcasts a fun Learning Material, where content is delivered with greater concern for graphical design features (such as infographics, moving illustrations and narration). On the other hand, the percentage of students who considered the ease of understanding for the Study Guide as "adequate" (69.2%) was significantly higher than for the Podcast (38.6%) ($z=-4.95$, $p<0.0001$). This is consistent with instructor's goal of producing study guides whose difficulty level is consistent with the course pre-requisites and the students' level of prior knowledge.
- **Relevancy:** the proportion of students who considered the Learning Material to be "pertinent to their learning needs" was significantly higher for the Study Guide (78%) than the Podcast (63%) ($z=-2.54$, $p=0.01$).

As a general result, the survey that was applied was able to provide instructors with relevant information about the two Learning Materials. It gave a quick and useful insight into how these specific Learning Materials were perceived by the students within the general context of the course and where future design efforts should be directed.

2.4.2 Research Question 2

With regards to the second research question (*What can institutions learn by assessing the User Experience of their learning materials?),* Table 10 summarizes the responses from all 382 respondents for the second part of this study (Stage 4 of the methodology). This summary is presented in terms of the five dimensions of User Experience for the Learning Materials that were assessed.

Table 10. General User Experience of Learning Materials

Amount of Information					
	Short	Adequate	Extensive		Total
Count	42	271	69		382
% of total	11,0	70,9	18,1		100,0
Learning Goal					
	Apply knowledge to professional context	Prepare myself for test taking	Understand conceptual aspects	Don´t know	Total
Count	30	251	89	12	382
% of total	7,9	65,7	23,3	3,1	100,0
Usefulness					
	Little Useful	Adequate	Very Useful		Total
Count	34	175	173		382
% of total	8,9	45,8	45,3		100,0
Ease of Understanding					
	Hard	Adequate	Easy		Total
Count	31	196	155		382
% of total	8,1	51,3	40,6		100,0
Relevancy with learning needs					
	Unlinked	Somewhat	Pertinent		Total
Count	9	96	277		382
% of total	2,4	25,1	72,5		100,0

From Table 10, we can make the following observations:

- **Amount of information:** The majority of students (70.9%) consider the amount of information in their Learning Materials to be “adequate”. This provides an idea of

how aligned the materials are with the time that the students have available to use them.

- **Learning goal:** The majority of students consider the Learning Materials to be crucial when it comes to preparing for a test (65.7%). Only 7.9% of the students considered the main goal was to help them apply the knowledge to a professional context.
- **Usefulness:** As many as 45.8% and 45.3% of the students believed that the Learning Materials were "adequate" and "very useful", respectively. If the students' main goal was academic achievement, then these artifacts were clearly helpful.
- **Ease of understanding:** Similarly, in terms of the ease of understanding, 51.3% and 40.6% of the students believed the Learning Materials were "adequate" and "easy", respectively. This provides the sense that the content of the materials was well chosen and adapted to the students' prior knowledge and experience.
- **Relevance to learning needs:** As many as 72.5% of the students believe that the Learning Materials provided by their instructors are pertinent to their learning needs. To a certain extent, this also reveals how much the students trust these information artifacts.

Table 11 shows the results of the 382 responses, categorized by gender

Table 11. Perception of Learning Materials by gender

Amount of Information						
		Short	Adequate	Extensive		Total
Male (N=257	Count	30	185	42		257
	% of total	11,7	72,0	16,3		100,0
Female (N=125)	Count	12	86	27		125
	% of total	9,6	68,8	21,6		100,0
	Z-statistic	0,447	0,518	-1,074		
	p-value	0,328	0,302	0,858		
Learning Goal						
		Apply knowledge to professional context	Prepare myself for test taking	Understand conceptual aspects	Don´t know	Total
Male	Count	24	161	66	6	257
	% of total	9,3	62,6	25,7	2,3	100,0
Female	Count	6	90	23	6	125
	% of total	4,8	72	18,4	4,8	100
	Z-statistic	-1,074	-1,744	1,517	<0.0001	
	p-value	0,858	0,959	0,065	0,500	
Usefulness						
		Little Useful	Adequate	Very Useful		Total
Male	Count	22	113	122		257
	% of total	8,6	44,0	47,5		100,0
Female	Count	11	63	51		125
	% of total	8,8	50,4	40,8		100,0
	Z-statistic	1,128	-1,073	<0.0001		
	p-value	0,130	0,858	0,500		
Ease of Understanding						
		Hard	Adequate	Easy		Total
Male	Count	18	137	102		257
	% of total	7,0	53,3	39,7		100,0
Female	Count	13	60	52		125
	% of total	10,4	48,0	41,6		100,0
	Z-statistic	-0,246	0,794	-0,886		
	p-value	0,597	0,214	0,812		
Relevancy with learning needs						
		Unlinked	Somewhat	Pertinent		Total
Male	Count	8	60	189		257
	% of total	3,1	23,3	73,5		100,0
Female	Count	1	37	87		125
	% of total	0,8	29,6	69,6		100,0
	Z-statistic	0,676	-1,164	1,278		
	p-value	0,249	0,878	0,101		

There are no statistically significant differences in the students' responses when categorized by gender (Table 11). Table 12 shows the responses categorized by instructional cycle.

Table 12. Perception of Learning Materials by instructional cycle

Amount of Information						
		Short	Adequate	Extensive		Total
First Cycle	Count	24	162	40		226
	% of total	10,6	71,7	17,7		100,0
Last Cycle	Count	18	110	28		156
	% of total	11,5	70,5	17,9		100,0
	Z-statistic	-0,115	0,133	<0.0001		
	p-value	0,546	0,447	0,500		
Learning Goal						
		Apply knowledge to professional context	Prepare myself for test taking	Understand conceptual aspects	Don´t know	Total
First Cycle	Count	11	158	50	7	226
	% of total	4,9	69,9	22,1	3,1	100,0
Last Cycle	Count	19	93	39	5	156
	% of total	12,2	59,6	25,0	3,2	100,0
	Z-statistic	-2,269	1,961	-0,527	<0.0001	
	p-value	0,988	0,025	0,701	0,500	
Usefulness						
		Little Useful	Adequate	Very Useful		Total
First Cycle	Count	14	108	104		226
	% of total	6,2	47,8	46,0		100,0
Last Cycle	Count	19	68	69		156
	% of total	12,2	43,6	44,2		100,0
	Z-statistic	-1,773	0,706	0,241		
	p-value	0,962	0,240	0,405		
Ease of Understanding						
		Hard	Adequate	Easy		Total
First Cycle	Count	11	111	104		226
	% of total	4,9	49,1	46,0		100,0
Last Cycle	Count	20	86	50		156
	% of total	12,8	55,1	32,1		100,0
	Z-statistic	-2,442	-1,055	2,687		
	p-value	0,993	0,854	0,004		
Relevancy with learning needs						
		Unlinked	Somewhat	Pertinent		Total
First Cycle	Count	5	55	166		226
	% of total	2,2	24,3	73,5		100,0
Last Cycle	Count	4	42	110		156
	% of total	2,6	26,9	70,5		100,0
	Z-statistic	<0.0001	-0,449	0,511		
	p-value	0,500	0,673	0,305		

The analysis in Table 12 reveals that there are no statistically significant differences when comparing the students' responses by instructional cycle (i.e. first and second half of the degree program).

2.5 Conclusion

This study defines a general framework for assessing Learning Materials, crucial information artifacts that are integral part of the Student Experience in any Higher Education institution. Within this framework, the Learning Materials are linked to the course design and instructional delivery. At the same time, these materials may also reflect the prevailing pedagogical policy and practice at the relevant institution. A survey was conducted at two large universities in Chile so as to observe the students' User Experience of certain Learning Materials. This was first done for a specific course at Institution A, before it was scaled up and applied to the entire student population at the School of Engineering at Institution B.

In response to our first research question (*How can educators assess the Student Experience of Learning Materials that are created in order to meet their learning objectives?*), to the best of our knowledge no previous study has focused on evaluating both the inherent and contextual elements of the User Experience of Learning Materials. Instead, existing assessment frameworks have focused on aspects such as: Search strategies adopted by students when using Learning Materials (Zamari, 2012), Visual Design strategies for improving learning (Jin, 2013), and the assessment of computer platforms for delivering Learning Materials (Young, Jeong & Yi, 2014). These are all crucial elements that affect the User Experience of Learning Materials. However, we believe it is important to provide a straightforward framework, such as the one presented in this study, which can identify the adequacy, relevance and use of the Learning Materials in question.

Furthermore, providing an assessment framework may stimulate discussion among instructors as to which goals should be pursued when redesigning materials. Based on the study by Boschman et al. (2016), we can infer that this type of discussion is not only necessary, but essential for raising practical concerns regarding how the materials and learning activities should be designed and delivered in order to foster certain learning outcomes.

In response to our second research question (*What can institutions learn by assessing the User Experience of their learning materials?*), from a pedagogical perspective this study highlights the instructors' deep pedagogical content knowledge. From a design perspective in particular, the rating given by students to dimensions such as "relevancy" and "usefulness" demonstrates the high level of skill that instructors possess as designers. This is especially true in terms of how accurately they are able to assess their students' learning needs. This is in line with what Kirschner (2015) identifies as a new skill that has been acquired by teachers in terms of their ability to re-use and re-combine different pieces information to create useful pedagogical units. According to Schoonenboom et al. (2009), this allow instructors to adapt these information artifacts to meet their teaching needs.

From an institutional-learning perspective, the survey results reveal a heavy focus on test-taking skills. This therefore demonstrates that the use of the Learning Materials is mostly driven by the students' need to perform well and meet the course requirements, rather than applying their knowledge to a professional context, which should be their main objective. This finding is in line with Junus et al. (2015), in which the motivation to learn by using a

student-centered system was associated with positive encouragement from the instructor and/or academic incentives.

Based on the large number of students who feel that Learning Materials are essential for test-taking, these materials are well-aligned with the prevailing instructional model (based on lecture-style classes, transfer of knowledge and test taking). This is in line with Olsson (2017) and French & Kennedy (2016), who suggest that a significant part of the student experience in higher education is related to content-based teaching.

2.6 Limitations and future work

One limitation of the present study is related to the fact that only two specific Learning Materials were assessed for one specific course at the first institution. Future research should test more types of artifacts, providing multilevel comparisons. While the results allowed us to understand how two asymmetrical Learning Materials were perceived, it would be interesting to compare different materials that are closer in terms of their format.

Even though the assessment framework allowed us to research the perception of Learning Materials at a large School of Engineering, additional research is needed in order to conclude whether this pattern is observable in a broader range of educational contexts.

We believe that the User Experience assessment framework that was developed and tested in this study allows for a significant understanding of how a general set of learning artifacts can have an impact on the pedagogical context of a Higher Education institution. Based on our

findings, we also believe that it is important to address the following questions in future research: Which other dimensions of User Experience can be included in the assessment framework? Can Learning Materials foster Conceptual Learning? Can Learning Materials enhance the relationship between subject knowledge and its application in professional scenarios?

3. ONLINE SURVEY: A NATIONAL STUDY WITH SCHOOL PRINCIPALS

3.1 Introduction

Globally, government infrastructure and service processes have been heavily impacted by Information and Communication Technologies, or ICT (Scholl et al., 2016). Within this context, public information providers face the challenge of implementing information products that are effective and efficient, while ensuring high levels of satisfaction (Pan et al., 2016; Hsiao et al., 2015). Although access to information has improved thanks to innovations in technology, e-government has only recently adopted a citizen-centric approach (García-García, 2016). This has led to improvements in the methods and mechanisms that are used for understanding and surveying user needs in order to improve the implementation of ICT products designed for public use (Kubicek & Aichholzer, 2016).

In terms of the interaction landscape, government consultations with its users are largely based on a diverse set of devices, methods and technological systems. These range from widespread and simple instruments to more complex and specific ones, including online surveys, forums, wikis, online monitoring systems and augmented reality systems, among others, which represent a heterogeneous body of information gathering devices (Aichholzer & Strauß, 2016).

Despite technological developments and improvements in policies for e-participation, the process of consultation has not changed significantly from traditional means of gathering information, such as online surveys sent via email (Alathut et al., 2016). These traditional

instruments are currently facing two main problems. On the one hand, online surveys have reportedly been experimenting lower response rates when applied in different contexts (Guo et al., 2016; Keusch, 2015). On the other hand, email has been associated with a series of negative effects in the workplace: information overload (Sobotta & Nessling, 2016), interruptions (Stadin et al., 2016), the expectation of an immediate response (Paczkowski & Kuruzovich, 2016), distractions (Hanrahan & Pérez-Quiñones, 2015), increased workload and stress (Jerejian et al., 2013).

With governments pushing to actively engage its citizens and collaborate with them on improvement projects, the current level of information provided by citizens regarding their daily life will most likely increase (Alexander et al., 2016). This raises a concern about how public organizations will deliver effective information-gathering devices using the Internet, while avoiding the risk of overwhelming stakeholders and ensuring response rates that contribute to the validity of their conclusions (Petrovčič et al., 2016).

This concern also includes the education sector; particularly school principals. Due to significant changes in their leadership roles and daily work processes, the school principal's management and leadership roles have become strategic in terms of government related products and information reaching internal communities of practice in each school (Hult et al., 2016). Additionally, the inclusion of quality attributes in education has aimed to transform public school practices into efficient performance and measurable outputs (Morgan & Volante, 2016).

Important characteristics of the work of school principals have been evidenced in the recent literature. As they are in a leadership position, principals need to use their time efficiently (Grissom et al., 2015), while most of their time is devoted to a multiplicity of administrative tasks (Lavigne et al., 2016). Furthermore, they are also faced with increasing government responsibilities regarding teacher observations and assessment (Donaldson, 2011). Therefore, this study is intended to clarify best practices in public consultations, based on a representative sample of school principals in Chile. Since school principals have very limited time available, understanding how they respond to an online survey can provide an insight into their attitudes regarding e-participation, as well as providing government agencies with valuable data for designing and implementing successful information gathering processes.

3.2 Literature review

3.2.1 Impact of email scheduling on response rate and response time

Due to their extensive use in e-participation, the use of online surveys in social sciences has been the subject of a significant body of research over the last decade (Guo et al., 2016; Fan & Yan, 2010; Shih & Xitao, 2008). In the seminal study by Kanuk & Berenson (1975), any elements of a survey related to enhancing survey structures in order to improve response rates can be categorized as "timing tools" (i.e. preliminary, concurrent and follow up efforts) or "technique tools" (i.e. format, design of message, length, deadlines and rewards, among others). Table 13 summarizes the research findings from a set of technique tools, most of which were controlled variables in this study.

Table 13. Literature review of technique tools used in the study

Nº	Element of study	Authors	Relevant findings	Applicable to this experiment
1	Length of message and header	Wright & Schwager (2008); Evans & Mathur (2005)	Quicker response when the header and message before the survey link are shorter.	Yes, controlled variable. Email subjects and messages made as short as possible.
2	Personalization of invitation to participate	Joinson & Reips (2007)	Observed a 6.5% increase in response rate compared with a generic header.	Yes, controlled variable. Each school's name was included at the beginning of the emai.
3	Post-survey incentives	Muñoz-Leiva et al. (2010)	Increased predisposition to participate and complete the survey.	No, the Quality of Education Agency does not rely on incentives for their studies.
4	Sampling by age	Dernardo & Curti (2013)	The Internet is a useful tool for collecting data with a population aged over 50.	No, the school database does not include age.
5	Sponsorship and organizational ties	Boulianne et al. (2011)	Better response rate when survey has a sponsor that is meaningful for the respondents.	Yes, controlled variable, logo and name of the Quality of Education Agency appears in the sender field and body of the email.
6	Pre-paid incentives	LaRose & Tsai (2014)	Sending prospective respondents nominal, pre-paid cash incentives via post is recommended as a way to reduce non-response error.	Yes, controlled variable. Survey response data was stored in institutional servers of the
7	Position of link to the survey	Kaplowitz (2012)	Placing the URL survey link at the bottom of the	Yes, controlled variable. Survey link should be displayed

			invitations increased response rates.	without having to scroll through the email.
8	Questionnaire length	Campanelli et al. (2016); Galesic & Bosnjak (2009)	Response rate was significantly higher for a 10-minute survey than for a 30-minute survey (75% vs 63%, respectively)	Yes, controlled variable. Design of a 5-minute survey, tested with n=20. One answer allowed per question.
9	Plea for help	Petrovčič et al. (2016); Porter & Whitcomb (2003)	Requesting help in an e-mail about a survey does have an effect.	Yes, controlled variable. Message in invitation mail designed to ask for help.
10	Authoritative message	Kaplowitz (2012)	Use of an authoritative subject line rather than one seeking participation in a survey also increased response rates.	Yes, controlled variable. Follow-up email contained an authoritative message.
11	Simple wording of email message and survey	Evans & Mathur (2005)	A less complex message structure allows for faster reading and an improved response rate.	Yes, controlled variable. Invitation email consisted of 157 characters including spaces. Reminder email contained 259 characters including spaces.

Secondly, the "timing tools" category covers different elements that have also been researched: advance notification, testing particular times of the day for sending emails and repeated follow up messages. The underlying idea has been that the process of surveying should look for instances in which potential respondents are more willing to participate in a survey (Keusch, 2015).

Email scheduling for online surveys is another element that can be considered within the

category of timing tools. From an information provider's point of view, modulation of email scheduling can result in enhanced response rates and response times. In the particular case of our study, school principals have become increasingly busy due to the new leadership roles they have assumed in their communities (Tubin, 2017). Therefore, their responsiveness to government-led consultation processes becomes critical, forcing public organizations to define ways to manage the consultation process more effectively.

In 2004, Faught et al. conducted an experiment in which they found that Wednesday morning (10:00 AM) had a positive effect on response rate, increasing from 2.66% to 4.10% (N=4,994, U.S. manufacturers). Almost a decade later, Sauermann and Roach (2013) concluded that changing the day and time of sending a survey did not have any significant effect on the response rate (N=24,661, U.S. graduate students and postdoctoral researchers). Therefore, the findings from studies on how timing affects response rate is still inconclusive. Considering that these studies have included sponsor-based surveys, this may be considered a gap in the research, particularly since attitudes towards this particular type of survey have traditionally been related to the concept of authority-obedience (Keusch, 2015).

With regards to response time, Revilla & Ochoa (2015) considers it as "paradata" that serves to evaluate the quality of a survey based on user behavior. Ilieva et al. (2002) report that the average response time for online surveys is 5.59 days. However, some studies suggest that the response time is a problem-dependent issue (Hardigan et al., 2016). Therefore this paper's first research question asks: *How does email scheduling impact the response rate and response time for a government-sponsored, online survey of school principals?* Given the lack of time and increasing workload faced by schools principals, exploring these outputs of an online survey will provide an insight into how online surveys are received within this specific context.

A second dimension of timing is related to exploring the effect of repeated contacts or follow-ups. The literature on this factor is more conclusive and, in general terms, it has been suggested that sending at least three reminders (Dillman et al., 2014) has a positive effect on participation by respondents. Sauermann and Roach (2013) explored a dynamic strategy, in which they changed both the timing and wording of follow up messages, with the idea of reinforcing the relationship between the researcher and the respondent through non-linear communication. They found that changing the wording increased the odds of a response by 30%. Hardigan et al. (2016) explored the effect of sending a follow up email two weeks after the original message containing the web-link had been sent. Their findings suggest that emails experienced a lower response rate (6.8%) than traditional mail (21%), while a hybrid method of survey delivery resulted in a 3.2% response rate. In a meta-analysis, Göritz & Crutzen (2011) concluded that reminders increase the response rate to web-based data collection methods from 49.5% to 65.6%. They provide data linking the study to the educational context, but do not specify which members of the school communities were

involved (teachers, principals, administrators, etc.). It is well-known that school principals have seen their duties increase due to additional administrative and leadership roles (Hansson & Wihlborg, 2016) and that they therefore have less time for administrative tasks, such as responding to surveys. Therefore, our second research question asks: *What is the impact on response rates and response times of a reminder email sent a week after initial contact with school principals?*

3.2.2 Influence of embedding surveys in an email

With the development of survey platform technology, new possibilities are emerging: easier analysis of results, novel questioning features and monitoring of respondent data, among others (Borden et al., 2016). In Human-Computer Interaction with digital systems one of the key features of navigation is the number of clicks required by a user in order to reach a certain goal. The literature has reported that fewer clicks by users leads to higher usability scores (Mosaly et al., 2016), less user error and, in general, better user performance (Porter et al., 2016; Unertl et al., 2016). Online surveys also contain a "navigational structure". A basic route starts with receiving an email, opening the electronic message, reading the message and clicking on a link to the survey. Additional steps might include an initial "home page" for the survey with informed consent or an introductory message. We did not find any studies related to the navigational issues of online surveys, specifically the effect of the number of clicks required to reach the actual survey device or a comparison of the time required between steps and the response rate. We believe this is an important issue since the possibility of embedding a survey in the body of an email can reduce the number of clicks needed to reach the survey and, more importantly, reduce the time needed to start answering the survey, thus

minimizing interruptions for the potential respondent. Considering this, our third research question asks: *How does a survey embedded in an email compare with a web-based survey?*

3.3 Research method

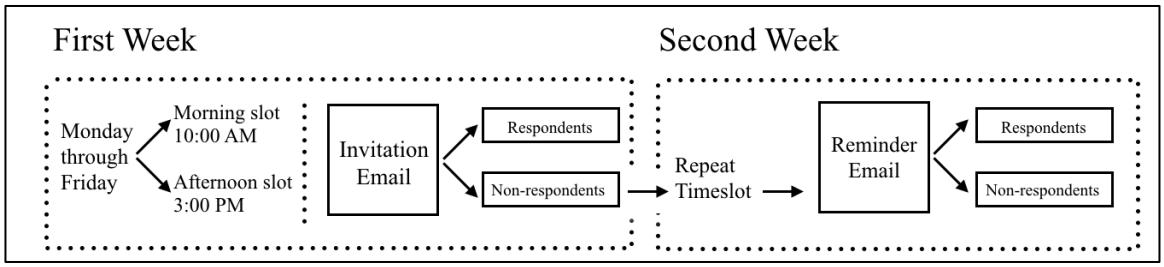
The data for this study is taken from a study carried out by the research team and Chile's Quality of Education Agency. The Agency is an integral part of the Ministry of Education's System for Quality Assurance. The objective of the Agency is to evaluate, inform and guide the education system in order to achieve higher levels of quality and equity. The agency has been a strong advocate for using ICT in their processes, ranging from online repositories of materials to personalized reports for schools with an assessment of their students' mathematics, writing, reading, and science skills and knowledge, in addition to results from international tests such as PISA, TIMS and ICILS, among others.

3.3.1 Procedure for Study 1: Effect of email scheduling on response rate and response time

In order to understand the influence of a set of scheduling conditions on response rates and response times, a representative sample of 1,000 school principals in Chile were randomly assigned to 10 different time slots over two weeks. These specific conditions were the result of dividing the workweek into ten time slots: Monday through Friday was subdivided into morning slots (10:00AM) and afternoon slots (3:00 PM). For each time slot, the emails for one hundred school principals were chosen at random from a database provided by the Quality of Education Agency. The definition of these weekly emails was based on the study conducted by Faught et al., 2004, which the research team found to be applicable to the

context of school principals in terms of their daily work schedule. The process of the experiment is described in Figure 10.

Figure 13. Process of sending email invitations and scheduling reminders



The first week cycle allowed for the data provided by the respondents and non-respondents to be analyzed independently. Each group from the first week was contacted again in the same time slot in the second week so as to complete the process of the experiment. The messages contained in the invitation and remainder emails were different (see Appendix C for the email templates).

Data was collected by sending an online survey with a specially designed and implemented web-platform hosted by the Agency. The web-platform was able to send emails to all of the principals in each time slot within a 5-minute time range. The survey itself consisted of five questions. All of the questions were mandatory and the system would ask respondents to complete any missing information if the survey was not completed. The aim of the survey was to assess the usability of an Agency-sponsored report sent six months previously to every school in the country. This annual report provides personalized information about each school's performance on a national standardized test. The email was sent directly by the Agency from an Agency email account, therefore avoiding the respondents' spam filters. The

survey was based on response-enhancing practices reported in the literature and described previously in the literature review section. The questions and response options were validated by two focus groups with two independent teachers from the University's doctoral program, as well as three teachers from the Quality of Education Agency, with extensive experience of the Chilean school system. The survey methodology was then corroborated by the head of the Agency's Community Information Division, as well as its staff of professionals.

Reminder emails were sent to each principal in the same time slot as the initial contact, though containing a different message (see Appendix C for the email template).

The five questions and the final design of the survey can be found in Appendix D.

3.3.2 Procedure for Study 2: Effects of embedding the survey in an email on response rate and response time

Every year, the Quality of Education Agency conducts 1-2 studies on information usage by schools. These representative inquiries require time and availability from school principals in order to answer phone surveys, email surveys and, in some cases, participate in focus groups. Given that an internal study was to follow this, the head of the Community Information Division suggested that a proper sample for study 2 should include less than 5% of all the emails in their database, so as to reduce the risk of information overload. Therefore, a sample of 100 principals (2.8% of the sample population) was randomly selected from the Agency's database. Due to the survey tool that was used by the research team, in order for respondents to see the survey embedded in the body of the email their email account had to be powered by Google. (Appendix E) At the same time, the Agency provided the research team with an institutional email account, also powered by Google.. Emails were sent out on

Wednesday, which is the best day for boosting response rates according to the study by Faught et al. (2004). The emails were sent in the afternoon time slot as this is when the level of activity at schools tends to decrease.

Both studies were carried out over a period of two weeks at the beginning of November, 2016. This is a particularly busy period as it is the end of the school year. However, the Quality of Education Agency gave the study a sense of urgency for two reasons: a) the need to assess the Usability of the annual report sent to schools across the country six months earlier, therefore assuring the quality of the responses while the report was still valid and in use and b) the institutional need to understand the responsiveness of all stakeholders in the school system, given the continuous need for consultation. Participation in the study was voluntary and no incentives were offered.

3.3.3 Participants

A national database was provided by the Quality of Education Agency and contained 9,047 school principals' names, email addresses and information on their schools, such as type of funding (public and private), location (urban, rural) and specific location within the different regions of the country. This database comprises all of the schools that received a quality assessment report from the Agency for the period 2015-2016.

For study 1, a representative sample of 1,000 participants was randomly selected, ensuring that it was a representative sample in terms of school funding type. On the other hand, study 2, which was explorative in nature, was not representative. In this case, a sample of 100

participants was randomly selected from a total of 3,606 schools where the principal had a Gmail account. Table 14 shows the relative proportions of private and public schools in the sample (the public schools in the sample includes charter schools, N=385), as well as the proportion of participants with a registered Gmail account, as opposed to other types of account.

Table 14. Study samples

Type of funding	Number in database	Dayabase proportion	Sample number	Sample proportion
Public	8591	94.46%	943	94.30%
Private	456	5.00%	57	5.70%
Total	9047	100.00%	1000	100.00%
Type of email provider				
Gmail	3606	39.90%	100	2.80%
Other	5440	60.10%	100	1.80%
Total	9046	100%	200	4.60%

A total of 1,838 emails were sent over a period of two weeks. 1,000 emails were sent out during the first week, of which 7 bounced. Therefore, a total of 993 emails were delivered during in the initial contact. In the second week, 845 reminder emails were sent to the recipients who had not responded during the first phase.

3.3.4 Measurements and data analysis

Six different measurements (dependent variables) were structural to the study. Measurement 1 to 3 (Table 15) are related with response rate, which is the main outcome in terms of the sample population's interest in participating. Response rate is also related to the validity of the results of a survey (Sánchez-Fernández et al., 2012). A second group of dependent variables is represented by measurements 4 to 6. These measurements are linked to the time that elapsed between sending the survey and three different actions: opening the email, clicking on the link to the survey and completing the survey. The time data was measured in

terms of minutes in order to facilitate the calculation of statistical significance. To examine the effect of email scheduling (independent variable) on these six measurements, the data was analyzed using different statistical tests in order to define whether or not the results for the selected measurements were significant. Due to the nature of the data (categorical in the case of response rates and numerical in the case of response times), a Chi-Squared test, T-test and analysis of variance (ANOVA) were conducted. Analysis was performed using statistical software (STATA v.121).

Table 15. Operational measurements of the study

Nº	Measurement	Definition
1	Total response rate	Number of total responses over the total population sample
2	First contact response rate	Number of responses over total emails delivered in the first contact cycle.
3	Reminder response rate	Number of response over total emails delivered in the follow up cycle
4	Response time for opening email	Average of hours and minutes passed from email sending to opening email in inbox
5	Response time for clicking survey link	Average of hours and minutes passed since first email sending to clicking the survey link
6	Response time for completing survey	Average of hours and minutes passed since email sending to response recording

3.4. Results

3.4.1 Effects of email scheduling on response rate

On average, the experiment reveals a total response rate of 31.7% over the two-week cycle (315 responses from a sample of 993 participants). The effect of each time slot on response rate is shown in Table 16.

Table 16. Summary statistics for the data collected on response rate

Timeslots	Day Nº	First Contact			Day Nº	Reminder		
		Emails received	Responses	Response rate		Emails received	Responses	Response rate
Monday 10AM	1	100	21	21.00%	11	76	19	25.00%
Monday 3PM	2	97	10	10.31%	12	85	21	24.71%
Tuesday 10AM	3	99	7	7.07%	13	92	18	19.57%
Tuesday 3PM	4	100	13	13.00%	14	85	15	17.65%
Wednesday 10 AM	5	100	19	19.00%	15	80	15	18.75%
Wednesday 3PM	6	100	14	14.00%	16	82	25	30.49%
Thursday 10AM	7	99	7	7.07%	17	88	18	20.45%
Thursday 3PM	8	99	11	11.11%	18	85	21	24.71%
Friday 10AM	9	99	11	11.11%	19	87	16	18.39%
Friday 3PM	10	100	14	14.00%	20	85	20	23.53%
Total		993	127			845	188	
Average				12.79%				22.25%

In order to measure the effect of email scheduling, different association tests were carried out (Table 17). Comparisons 5 and 6 add two contextual factors linked to the particular characteristics of each respondent in the sample, namely the type of funding and location of the school. These were tested independently in order to add contextual understanding to the study.

Table 17. Effect of email scheduling and contextual variables on response rate

Comparison of response rate	Survey response rate	Chi-square	p-value
1. General Result			
First Contact Cycle	12.79%		
Reminder Cycle	22.25%		
1.1 First conttact versus Reminder		$\chi^2(1,1838)=28.7628$	<0.05
2. Independent from cycle			
Morning timeslots	17.13%		
Afternoon timelots	17.15%		
2.1 Morning versus afternoon		$\chi^2(1,1838)=0.0001$	0.993
3. Only first contact cycle			
Morning timeslots	13.10%		
Afternoon timelots	12.47%		
3.1 Morning versus afternoon		$\chi^2(1,993)=0.0883$	0.766
4. Only reminder cycle			
Morning timeslots	21.06%		
Afternoon timelots	24.04%		
4.1 Morning versus afternoon		$\chi^2(1,845)=1.0349$	0.309
5. Type of funding			
Public	16.92%		
Private	20.75%		
5.1 Public versus private		$\chi^2(1,1838)=1.0360$	0.309
6. Type of location			
Urban	18.77%		
Rural	14.94%		
6.1 Urban versus rural		$\chi^2(1,1838)=4.6309$	0.031

The response rate for the reminder email is significantly higher than for the initial contact (Table 17). Emailing the online survey in the morning or afternoon time slots had no significant effect on the response rate in general. This is also the case when the initial contact and reminder emails are analyzed independently. Additional analysis was performed using the data for initial contact in order to understand the results independently from the reminder emails. No significant differences were found among any of the 10 time slots when the first message was sent. In terms of the contextual factors included in the analysis, the type of school funding (public or private) had no significant effect on the response rate. However, the location of the school did have a significant effect, with urban schools experiencing a significantly higher response rate than rural schools.

3.4.2 Effects of email scheduling on response time

On average, the response time for completing the survey was 1,590 minutes (26 hours and 30 minutes) during the initial contact phase. This response time decreased by 16% to 1,326 minutes (22 hours and 2 minutes) during the follow up phase. We analyzed this decrease statistically using a T-test. No significant difference was found between these two average response times. Data for each of the twenty time slots is included in Table 18.

Table 18. Summary statistics for the data collected on response time

		First Contact				Reminder		
Timeslots	Day Nº	Opening email	Clicking survey link	Responding survey	Day Nº	Opening email	Clicking survey link	Responding survey
Monday 10AM	1	721	1428	1061	11	642	1284	934
Monday 3PM	2	526	1184	1375	12	499	999	663
Tuesday 10AM	3	965	786	896	13	518	867	1735
Tuesday 3PM	4	930	1622	1478	14	730	1135	1048
Wednesday 10 AM	5	783	1377	1563	15	873	960	1170
Wednesday 3PM	6	1109	1589	1000	16	387	1111	1093
Thursday 10AM	7	1448	2185	3021	17	611	1027	1277
Thursday 3PM	8	942	2244	1402	18	1189	2108	1699
Friday 10AM	9	1616	2814	2460	19	1406	2062	1012
Friday 3PM	10	1357	1831	1645	20	1412	2910	2625
Mean		1040	1706	1590		827	1446	1326

In order to measure the influence of email scheduling on response time, different associations were compared in statistical terms. Table 19 outlines these measurements. No significant difference was identified in terms of the average response time for completing the survey when comparing initial contact with the reminder email. Moreover, emailing surveys in the morning or afternoon also did not reveal any significant difference in the average response time. Additionally, a one-way ANOVA was performed in order to understand the effect of the different time slots on the average response time for completing the survey. No significant effect was found. Contextually, the type of funding did not have any significant effect. However, the location of the school did have a significant effect on response time, t(313)=-255, p=0.011. In this sense, urban schools demonstrated a 34% faster response time than rural schools (i.e. they were approximately 10 hours faster at completing the survey). A second measure of interest was defined as the response time for opening the email.

Table 19. Effect of email scheduling on response time for completing the survey

Comparison of response time for completing survey	N	Mean	t-test	p-value
1. General Result				
First Contact Cycle	127	1511		
Reminder Cycle	188	1334		
1.1 First conttact versus Reminder	315	1405	t(313)=0.7339	0.4636
2. Moment of the day				
Morning timeslots	172	1314		
Afternoon timeslots	143	1515		
2.1 Morning versus afternoon	315	1405	t(313)=-0.8465	0.3979
3. Type of funding				
Public	293	1422		
Private	22	1186		
3.1 Public versus private	315	1405	t(313)=0.5106	0.61
4. Type of location				
Urban	198	1176		
Rural	117	1794		
4.1 Urban versus rural	315	1405	t(313)=-2.5566	0.011

There was no significant difference in response time when comparing initial contact with reminder emails, as well as emails sent in the morning versus emails sent in the afternoon

(Table 20). However, the contextual factors did have an effect on the response time. Private schools were quicker to open the email than public schools (365 minutes versus 956). This 61% decrease in response time (approximately 10 hours) was found to be statistically significant, t(815)=-2.566, p=0.010. In terms of location, urban schools also demonstrated faster response times (796 min) when compared to public schools (1,140 minutes). This difference of 5 hours and 44 minutes also proved to be statistically significant, t(815)=-2.712, p=0.006.

Table 20. Effect of timing on response time for opening email

Comparison of response time for opening email	N	Mean	t-test	p-value
1. General Result				
First Contact Cycle	391	1001		
Reminder Cycle	426	832		
1.1 First conttact versus Reminder	817	913	t(815)=1.3993	0.1621
2. Moment of the day				
Morning timeslots	451	882		
Afternoon timeslots	366	951		
2.1 Morning versus afternoon	817	913	t(815)=-0.5687	0.5697
3. Type of funding				
Public	757	956		
Private	60	366		
3.1 Public versus private	817	913	t(815)= 2.5664	0.0105
4. Type of location				
Urban	539	796		
Rural	278	1140		
4.1 Urban versus rural	817	913	t(815)=-2.7128	0.0068

Finally, the action of clicking on the link to the survey included in the email was also recorded. Table 21reveals the same analyses that were conducted for the response time for opening the email and completing the survey. As with these previous analyses, the only factor that had a significant effect on the response time for clicking on the link was the school location. In this sense, we found a significant difference between urban and rural schools, with principals from urban schools clicking on the link approximately 10 hours sooner than their rural school counterparts.

Table 21. Effect of timing on response time for clicking on the link to the survey

Comparison of response time for clicking survey link	N	Mean	t-test	p-value
1. General Result				
First Contact Cycle	166	1622		
Reminder Cycle	221	1450		
1.1 First conttact versus Reminder	387	1524	t(385)=0.7766	0.4379
2. Moment of the day				
Morning timeslots	216	1353		
Afternoon timeslots	171	1740		
2.1 Morning versus afternoon	387	1524	t(385)=-1.7551	0.08
3. Type of funding				
Public	362	1539		
Private	25	1304		
3.1 Public versus private	387	1524	t(385)= 0.5993	0.5258
4. Type of location				
Urban	243	1297		
Rural	144	1907		
4.1 Urban versus rural	387	1524	t(385)=-2.7099	0.007

In order to look for any general pattern in the data, response times were coded according to the categories defined by Gauld et al. (2016). Four categories were used for this purpose and applied to all of the 1,839 data entries (Table 22).

In general, we can observe that 44% of the respondents opened the email (N=817), 47% of those who opened the email (N=387) decided to click on the link to the survey. Finally, of those who clicked on the link, 81% (N=315) completed and submitted the survey.

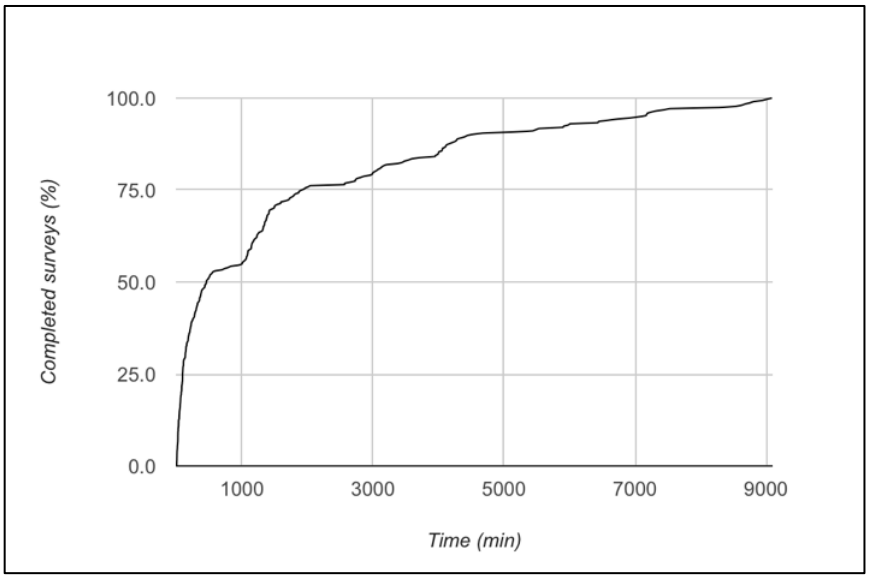
Table 22. Summary of coded response time for each of the three elapsed times

Time codes	Opening email	Clicking survey link	Survey responding
Less than 12 hrs	84	55	36
12-24 hrs	589	219	164
24-72 hrs	129	99	98
More than 72 hrs	15	14	17
Total	817	387	315

Additionally, the research team aimed to understand how much time elapsed in terms of the percentage of completed surveys. Figure 11 shows this relation, revealing that 50% of all completed surveys took about 500 minutes or 8.3 hours to complete. After a period of

approximately 16 hours, 75% of the surveys had been completed. Finally, it took slightly more than 6 days to receive all of the completed surveys.

Figure 14. Total response time versus Total completed surveys



3.4.3 Effect of embedding survey in email on response rate and response time

100 emails were sent using Gmail, with the survey embedded in the body of the email. Four of these emails bounced back, giving a total of 96 delivered mails. These emails were sent in the Wednesday afternoon time slot (3:00PM), which coincided with the 100 surveys that were sent as a link in the same time slot. As shown in Table 23, the first invitation cycle yielded a 15.63% response rate for the embedded survey, in comparison to 14% for the survey sent as a link. A chi-square test revealed that this difference was not significant.

Table 23. Summary statistics for comparison of embedded survey versus survey sent as link

	Day Nº	Emails received	Total responses	Response rate	Response time (mean)
First contact					
Google form	1	96	15	15.63%	2957
Weblink	1	100	14	14.00%	1000
Reminder					
Google form	2	81	10	12.35%	1278
Weblink	2	82	25	30.49%	1093

In general terms, the survey sent as a link enjoyed a higher response rate (21.43%) than the Google forms survey (14.12%) (Table 24). A chi-square test also revealed that this increase was not significant. Similarly, the response rate to the embedded survey between the initial contact and reminder email did not reveal any significant differences. However, the response to the survey sent as a link did increase significantly between initial contact (14.00%) and the reminder email (30.49%), $\chi^2(1,182)=7.274$, $p=0.007$.

Table 24. Effect of survey type on response rate

Comparison of Response Rate	Survey Response Rate	Chi-square	p-value
1. General results			
Google Forms	14.12%		
Weblink	21.43%		
1.1 Google Forms versus Weblink		$\chi^2(1,359)=3.2681$	0.071
2. Over both cycles			
Google Forms 1st contact	15.63%		
Google Forms reminder	12.35%		
2.1 Google Forms 1st contact versus Google Forms reminder		$\chi^2(1,177)=0.3895$	0.533
Weblink 1st contact	14.00%		
Weblink reminder	30.49%		
2.2 Weblink 1st contact versus Weblink reminder		$\chi^2(1, 182)=7.2746$	0.007
3. Only first contact cycle			
Google Forms	15.63%		
Web link	14.00%		
3.1 Google Forms versus Weblink		$\chi^2(1,196)=0.1026$	0.749
4. Only reminder cycle			
Google Forms	12.35%		
Web link	30.49%		
4.1 Google Forms versus Weblink		$\chi^2(1,163)=7.9540$	0.005

The survey type had no significant effect on response rate for the initial contact. However, during the reminder phase the survey sent as a link experienced a significantly higher response rate (30.49%) than the Google forms survey (12.35%), $\chi^2(1,163)=7.954$, $p=0.005$ Table 25 shows the average response time for completing the survey. The results reveal an overall decrease of 53.65% in the average response time for completing the survey sent as a link.

This represents a difference of approximately 20 hours in the average response time, showing that sending a survey as a link is much faster at collecting responses.

Table 25. Effect of survey type on response time

Comparison of Response Time	N	Mean	t-test	p-value
1. General results				
Google Forms	25	2285		
Weblink	39	1059		
1.1 Google Forms versus Weblink	64	1538	t(62)=1.9620	0.0543
2. Over both cycles				
Google Forms 1st contact	15	2957		
Google Forms reminder	10	1277		
2.1 Google Forms 1st contact versus Google Forms reminder	25	2285	t(23)=1.2847	0.2117
Weblink 1st contact	14	999		
Weblink reminder	25	1092		
2.2 Weblink 1st contact versus Weblink reminder	39	1059	t(37)=-0.1577	0.8756
3. Only first contact cycle				
Google Forms	15	2957		
Web link	14	999		
3.1 Google Forms versus Weblink	29	1957	t(27)=1.8001	0.083
4. Only reminder cycle				
Google Forms	10	1277		
Web link	25	1092		
4.1 Google Forms versus Weblink	35	1145	t(33)=0.2585	0.7976

Analysis of the average response time for surveys sent as a Google Form and surveys sent as a link in an email does not reveal any significant differences for any of the other comparisons.

3.5 Discussion and Conclusions

Achieving higher response rates to surveys has become a challenge for government agencies (Al Hujran et al., 2015; Karunasena & Deng, 2012). This challenge must be overcome if such agencies are to base their decision-making on quality data, increase adoption of public services and develop population-wide estimates from specific and limited consultation processes (Rose-Ackerman & Palifka, 2016). Therefore, this study aimed to assess the responsiveness of a nationwide, representative sample of school principals to an online survey. We analyzed ten different weekly time slots, grouping them into two cycles: initial contact and reminder. Additionally, we explored the effect of two different survey formats, one extensively used and applied (a survey sent as a link) versus another emerging approach, which embeds the survey in the body of an email (Google Forms), reducing the need to navigate between opening the email and completing the survey. The reaction to the survey was measured using six different parameters related to response rate and response time.

With regards to our first research question, which asked whether the timing of an email had any effect on response rate and response time, our results reveal that the time slot had no significant effect on response rate. This result differs from the evidence presented by Faught et al., (2004) who reported a significant difference for a particular day of the week (Wednesday at 10:00AM), when compared with other time slots (Monday-Friday, morning vs afternoon). However, more recently Sauermann & Roach (2013) reported no significant differences based on the day and time at which online surveys are sent out. We also found that sending emails to school principals in the morning or afternoon over the two cycles had no significant effect on response rate. Contextually, it was found that schools located in urban

areas experienced a higher response rate than those in rural areas. Causes related to this phenomenon can be found extensively in the literature describing particular contexts such as inequality of access to technology (Bolaños & Solera, 2016), lower abilities and government support for installing and maintaining technology (Autio & Deussen, 2017) and reduced digital skills (Liao et al., 2016).

With regards to our second research question, which asked whether sending reminders had any effect on the response rate and response time, our results show that the response rate increased significantly following a second follow up message pleading for help. Similarly, the three different measures for response time decreased between initial contact and the reminder (response time for opening the email, clicking on the link and completing the survey). However, none of these differences were statistically significant. In our specific domain, the average response rate increased by 9 percentage points between initial contact and follow-ups. This increase is consistent with the evidence reported in the literature (Göritz & Krutzen, 2011; Sánchez-Fernández et al., 2012). The causes related to this increase in response rate may be connected with the design of the survey itself, according to the guidelines for response-enhancing features reported in the literature. These features include the government-sponsor characteristics of the email sender, an email message asking for help and changing the subject of the email from “five questions to build quality” to “reminder”.

As with response rates, the decrease in response time for all three actions that were recorded was related to contextual factors such as the school location. Urban schools were faster at opening the email, clicking on the survey link and completing the survey. We believe this

may reveal an important gap in the attitudes towards e-participation in both contexts and/or that email-related tasks are lower priority for school principals in rural areas.

Our third question explored the effect of embedding a survey in the body of an email on response rate and response time. We found no significant effect on response rate and response time when embedding the survey, as opposed to sending it as a link. When the respondents went to send their responses via Google Forms, a warning message appeared stating that the information would be sent to an external page. This may have lowered the response rate for this medium. Given that embedding the survey requires all users to have the same email host (in this case Google) our results are very specific to this particular study and its conditions.

We believe the response rate for this survey was significant given the period of the school year in which it was sent. However, the marginally significant effect on the response rate was not reflected in lower response times between the two cycles (initial contact versus reminder email). In other words, although the participants probably thought it was important to respond, their response was not made any quicker because of a follow up email.

In terms of being able to make inferences with regards to the school principals' time management and work tasks from the data that was collected, we can speculate that this type of leadership role requires them to focus on different tasks throughout the week, both during the morning and in the afternoon. Therefore, our study was not able to identify a specific time slot with a significantly better response rate or faster response time.

3.6 Limitations and future work

It is worth noting that the period in which the survey was sent is a particularly busy and stressful time for school principals. Therefore, future studies should compare our results with results from a different time of the year. Contextually, the type of location (urban versus rural) proved to have a significant effect on the response rate and response time. Further research is required in order to understand the factors behind this phenomenon.

4. USER EXPERIENCE OF PUBLIC SERVICE INFORMATION

4.1 Introduction

Due to developments in technology and the growing needs of society, government organizations are moving

towards increasingly complex systems of information products (Kumar et al., 2017; Malle et al., 2016). As the public sector has matured (Layne & Lee, 2001), the quantity, variety and functionality of information products has increased (Vetró et al., 2016). Despite recent efforts to improve information delivery, effective information usage remains a critical topic of action and research (United Nations, 2016). The asymmetry of the goals of information providers (public sector) and users (citizens) negatively affects the notion that accessible information ensures participation and civic action, as well as reinforcing the impact of democracy (Henninger, 2017; Dwivedi et al., 2012).

Public Service Information (PSI) includes textual and non-textual materials, datasets, maps, records and any printed or digital form of documentation or grey literature (Thorsby, J., Stowers, G. N. L., Wolslegel, K., et al., 2017; Henninger, 2016). Such information represents a significant portion of interaction with e-services such as websites, portals and apps. From a user perspective, previous studies have mainly focused on interaction with the latter. These studies describe core elements relating to Adoption Models (Dwivedi et al., 2017), Service Quality (Papadomichelaki & Mentzas, 2012), User Acceptance (Hung et al., 2009), User Experience (Kumar et al., 2017) and Usability (Youngblood & Youngblood, 2017).

However, interaction with Public Service Information has rarely been described in terms of User Experience. This presents a serious concern, since government services are producing more and more multimedia products (Sá et al., 2016; Pasman, 2011), as well as designing and publishing more and more documents (Henninger, 2017). Furthermore, the trend toward open data is currently impacting a range of activities, from policy-making to information usage (Martin et al., 2017; Janssen & Helbig, 2016).

As a developing country, Chile has declared that digitalization and modernization of its public services will improve levels of equality and democratic participation (Pressacco & Rivera, 2015). In 2004, a set of national guidelines were created to ensure minimum usability standards for public websites and platforms (Gobierno de Chile, 2006). Significant amounts of public funds have been invested in developing new information products. However, each government agency lacks the internal capabilities and resources (time & budget) to periodically assess the use of the information products that they provide (Palma et al., 2014). In this sense, Blakemore and Craglias' (2006) criticism of the notion; "if information is made available it will be used" becomes increasingly relevant. This is particularly true when faced with the challenge of matching the goals that drive the production of information with the needs of the users. This article addresses the need to develop processes for assessing User Experience for the design and production of Public Service Information (PSI) within the context of e-government. The article begins with a description of the concept of PSI and how it relates to the measurement and monitoring of Usability and User Experience. The methods used in this study are also discussed so as to provide an insight into the main characteristics of the data collection and data analysis processes. This particular study followed the action

research approach and was conducted in a public-sector organization in Chile serving the national school system.

4.2 Literature review

4.2.1. What is Public Service Information?

Public Service Information (hereinafter referred to as PSI) is defined as "*the wide range of information that public sector bodies collect, produce, reproduce and disseminate in many areas of activity while accomplishing their Public Task".* (https://data.gov.uk/glossary). Henninger (2017) provides a definition that goes beyond the idea of information itself: "*Australia considers public sector information (PSI) to be information products and services, generated, created, collected, processed, preserved, maintained, disseminated or funded by or for the Government or public institutions".* PSI has traditionally been associated with information items such as documents, maps, datasets, reports, press releases and textual material (Henninger 2017; Kalampokis, Efthimios and Tarabanis, 2011). However, with developments in multimedia content, the concept of PSI has been extended to include infographics, maps, videos and presentations (Amato et al., 2016). When implementing a system of e-government (Layne & Lee, 2002), Public Service Information initially involves the digitization of paper-based content, which then becomes the primary source of digital content for web-enabled information channels.

Sometimes referred as "behind the web" key enablers (Lörincz, 2010), Public Service Information has become increasingly important with the development and integration of web-based services (websites, portals, apps, etc.). Significant efforts have been made to standardize and improve access to the content that is produced by public services.

Furthermore, open-data publications are having a positive impact on usage levels (Mouzakitis et al., 2017; Jannsen et al., 2017). A key step towards standardizing and improving the quality of information involves providing a conceptual framework for classifying PSI. A series of studies that have addressed this issue are summarized below (Table 26).

Table 26. Classifications of Public Service Information documented in the literature

Nº	Title	Author/Year	Relevant Findings
1	A classification scheme for open government data: towards linking decentralized data	Kalampokis, Efthimios and Tarabanis (2011)	Definition of two dimensions for classifying Open Government Data initiatives: Dimension 1: Technological approach (downloadable files versus linked data) Dimension 2: Organizational approach (providing data directly versus providing it indirectly)
2	From e-government to we-government: Defining a typology for citizen coproduction in the age of social media	Linders (2012)	Definition of three dimensions in order to classify coproduction initiatives in the age of social media: a) Citizens to Government: the public helps the government to be more responsive and effective b) Government to Citizen: the public sector can help citizens improve their day-to-day productivity, decision-making, and wellbeing. c) Citizen to Citizen: coproduction, potentially presenting a substitute for traditional government services.
3	Modelling the public sector information through CIDOC conceptual reference model	Bountouri, Papatheodorou Gergatsoulis, (2010)	Proposal for the use of the CIDOC Conceptual Reference Model within the context of PSI.

4	Open Data as a Foundation for Innovation: The Enabling Effect of Free Public Sector Information for Entrepreneurs	Lakomaa and Kallberg (2013)	Relates Open Data to three, core elements: a) Government accountability b) Commercialization of products and services based on government data c) Innovation-enabling processes
5	Open data for democracy: Developing a theoretical framework for open data use	Ruijer, Grimmelikhuijsen and Meijer (2017)	Suggests that in order to be democratic, open data design must be: a) Monitorial b) Deliberative c) Participatory

Previous classifications of Public Service Information have mainly focused on Open Government Data initiatives (Table 26). This has become a key aspect of the production and publishing of Public Service Information. The majority of these classifications come from the perspective of the information provider (as opposed to the user) and focus on issues such as accountability, accessibility and technology.

There is a distinct lack of studies relating Public Service Information to User Experience. This only serves to strengthen the notion that PSI is a "static, one-way" process (Murray & Hsieh, 2008). In this sense, the process is largely removed from the context of the task facing the user, while there is also little chance to alter the outcome in terms of effectiveness and satisfaction. Furthermore, as producing digital information becomes more affordable for organizations it can lead to an abundance of information (Stohl, Stohl and Leonardi, 2016).

Therefore, providing a user-centered classification of PSI materials may represent a step towards acknowledging the visibility and use of public information products and services from a citizen's perspective. Considering this, our first research question asks: ***How can Public Service Information (PSI) materials be classified (or grouped) in terms of User Experience?***

4.2.2 Public Service Information as Usable Products

Measuring the User Experience (UX) of public e-services helps close the gap between the goals of information products and the tasks that citizens must complete with ease and satisfaction (Faisal et al., 2016). However, studies that examine a user's relationship with Information and Communication Technologies often focus on more interactive products (e.g. studies of Human-Computer Interaction within information systems). Furthermore, User Experience is a relatively new concept that has emerged from the field of Human-Computer Interaction and has been used to understand interaction with a wide range of products and services (Hornbæk & Hertzum, 2017). It has also successfully provided a quantification of user issues relating to innovations in e-government (De Róiste, 2013). In addition to this, there has also been significant debate in the literature regarding how UX relates to Usability. Some of the more established definitions are provided by the International Organization for Standardization (ISO), which defines the terms as follows:

- *User Experience is: "A person's perceptions and responses that result from the use and/or anticipated use of a product, system or service" (ISO FDis, 2009)*

- *Usability is: "The 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 (ISO FDis, 2009)*

These definitions reveal a great deal of overlap between the two concepts. However, the main distinction is that User Experience involves perceptions from both pre- and post-use. This is particularly relevant when evaluating government services, since a citizen's trust in the information that is provided by a public service can considerably affect their experience. Public Service Information materials have rarely been tested in terms of their Usability or User Experience. Table 27 summarizes a series of studies that analyze the main dimensions of User Experience and Usability.

Table 27. Summary of the literature regarding the assessment of the use of Public Service Information in e-gov

N°	Article	Author	Topic of Study	Relevant Finings
1	Understanding the content and features of open data portals in American cities	Thorsby et al. (2017)	Category-organization, machine-readable, data manipulation ability, online-charting potential, modification of data	Recommendation for consistency in the presentation of data across portals. The need to track the use and application of data charts and analysis to enhance the impact of information.
2	Evaluating the Quality and Usability of Open Data for Public Health	Martin et al. (2017)	Generation of summary indices for intrinsic data quality, contextual data quality, adherence to the	Standardization of data and metadata can increase usefulness for researchers (users of the data).

	Research: A Systematic Review of Data		Dublin Core metadata standards, and the 5-star open data deployment scheme	
3	Beyond utilitarian factors: User experience and travel company website successes	Wani et al. (2017)	Assessment of an Information System Model that integrates User Experience with three other dimensions: System Quality, Information Quality and Service Quality.	Provides a significant link between characteristics of the utilitarian system and the subsequent User Experience, within the context of travel websites.
4	Australian Public Sector Information: a case study into information practices	Henninger (2016)	Testing availability and accessibility of public documents on a website.	States the need to use web archiving tools for continuous provision of strategic Public Service Information
5	The circular continuum of agencies, public libraries, and users: A model of e government in practice	Taylor et al. (2014)	Analysis of information flow between three stakeholders: government, intermediaries and users.	Understanding the different pathways of information flow is necessary for building an information cycle that provides government information, communication and services to all users fairly.
6	Visual events and electronic government: What do pictures mean in digital government for citizen relations?	Bekkers & Moody (2011)	Analysis of five cases of e-government practices in terms of their functional, institutional and political meaning	The use of visual events as a persuasiveness element affecting diagnostic framing of citizens

7	The assessment of the information quality with the aid of multiple criteria analysis	Michnik & Lo (2009)	Assessment of the following dimensions: Access Accuracy Amount of information Believability Completeness Concise Representation Consistent Representation Convenience Ease of Understanding Interpretability Objectivity Relevance Reputation Security Timeliness Value needed	Development of an auxiliary tool for managing information quality when improving information systems and the definition of six strategies for improving information quality

Table 27 reveals that the literature has mainly focused on assessing dimensions such as "availability" and "accessibility". Furthermore, "Usability", "Information flow" and "Information quality" are all interconnected dimensions that can be strongly linked to the assessment of User Experience with PSI. Table 27 also shows that assessing User Experience can lead to synergies with the process of assuring the quality of the information. This in turn has a significant impact on the successful adoption of a system (DeLone and Mclean, 2003). In this sense, Wang & Strong (1996) proposed four dimensions for understanding the concept of Information Quality. To do so, the authors first examined the associations that are inherent

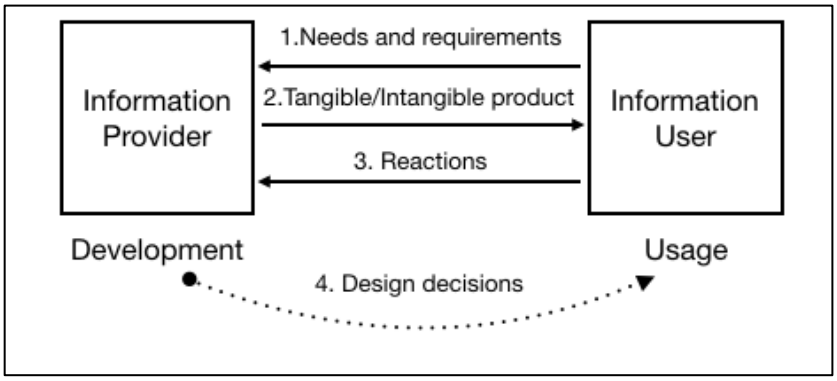
to the nature of the content. Following this, they extended these associations to the supporting systems through which the content is delivered. There are strong links between Public Service Information and content structure, and its supporting role with regards to information systems. It is therefore possible to represent the User Experience using the following four dimensions:

- Intrinsic quality: PSI must be perceived as containing accurate and trustworthy data that is produced and maintained by public agencies. Related items include: completeness, clarity, believability, objectivity, reputation, traceability and variety of data sources.
- Contextual quality: PSI must be perceived as being able to resolve the issues faced by citizens and must be in line with their decision-making process. Related items include: value-added, relevance, timeliness, ease of operation, appropriate amount of data.
- Representational quality: PSI must be relevant for citizens and delivered within a suitable timeframe. Related items include: interpretability, ease of understanding, representational consistency, concise representation.
- Accessibility: PSI must be delivered through public information systems in a safe, reliable and accessible manner. Related items include: accessibility, cost-effectiveness, access-security.

Based on the above framework, the *User Experience with Public Service Information* is defined in this paper as: *"A person's perception of and response to the accessibility and intrinsic, contextual and representational quality of information embodied in products and*

services delivered by government agencies to the public". Accordingly, assessing UX becomes a multidimensional task involving the user, the provider, the task and the context (Verdegem & Verleye, 2009). Koskinen & Jormakka (2010) defined a related concept, *Usability Monitoring*, as a continuous process of assessment in which a baseline value is monitored over time. However, although the monitoring process can be seen as a strategic action for an organization, it also involves added complexities in terms of resource management and infrastructure (Bell & Nusir, 2017; Zuiderwijk et al., 2014). One of the advantages of monitoring is that regular feedback can be received from users regarding the design of the PSI materials. The model proposed by Dragunalescu (Figure 12) frames the process for assessing the quality of a website. This model also establishes a parallel and dependent relationship between the information provider and the information user. This is because the design process is based on user-centered feedback and analysis. This process starts by identifying user needs and requirements, which then drives the development of a solution. Once the user has received the solution, the following outcome is the user's reaction to said solution. Although the model clearly states that the provider and user are both interlinked when it comes to the quality of an information product, no further relationships are established once the reactions to the solution have been manifested by the users. It is therefore possible to add an additional relationship to this model. This relationship is labeled 'Design decisions' in Figure 12 and has three possible outcomes: a) Design: the development of new PSI materials b) Re-design: improvements to existing materials and/or c) Elimination of materials.

Figure 15. Initial model for monitoring User Experience, based on the work by Dragunalescu (2002)



This model therefore provides a conceptual basis for understanding "monitoring" with regards to quality improvement and decision-making in the design process. Several calls have been made in recent years to deliver information to citizens effectively, while also monitoring usage and promoting simplicity, accessibility and usability (United Nations, 2016). Consequently, our second research question therefore asks: ***How can the User Experience of PSI be monitored over time in order to inform design decisions?***

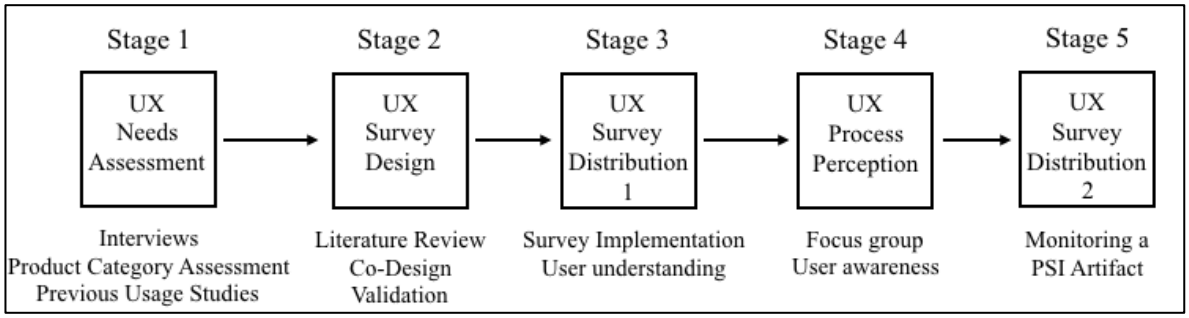
4.3 Research Method

Chile´s Quality Education Act establishes the state's responsibility for ensuring the quality of education in the country (http://www.agenciaeducacion.cl/orientacion/sac/). In this context, one of the main goals of the Quality of Education Agency (hereinafter the Agency) is to provide information to the general population on matters regarding Quality Assessment in order to improve the learning process. In this sense, the Agency delivers information to different stakeholders: school principals and administrators, teachers, parents, district supervisors, researchers, and the general public. The main goal of the present study was to develop and implement tools to improve the User Experience of the Agency's information products. To achieve this goal, an action research approach (Baskerville, 1999) was adopted. This approach was adopted based on two main factors:

a) The context of the study: a real problem within a specific social and organizational setting and b) The need to apply knowledge relating to methods for assessing User Experience within a research team comprising university researchers and public service professionals. Figure 13 summarizes the four main stages of the study, which began in September 2015 (stage 1) and ran until May 2017 (stage 4). Overall, the study involved 20 months of collaborative work. The work was carried out by a team of university researchers and professionals from the Agency's Information Division (see Appendix F for a detailed list of the participants and their roles). The Agency team included the Division head and another member of staff, who acted as the main coordinator. The study was approved by the University Institutional Review Board (ID Protocol: 160923007). The goals for each stage of the study were as follows:

- Stage 1: UX Needs Assessment: Identify organizational needs through User Studies and user-centered design.
- Stage 2: UX Survey Design: Develop an instrument that is able to capture the perception of User Experience from users of the school system.
- Stage 3: UX Survey 1: Distribute survey among 10,000 school principals in order to assess their perception of the 2015 Report for School Principals and Teachers.
- Stage 4: Perception of the UX Process: Identify perceptions within the organization that may encourage/discourage monitoring of the User Experience of the school system's stakeholders.
- Stage 5: Survey 2: Distribute survey among 10,000 school principals in order to assess their perception of the 2016 Report for School Principals and Teachers, as well as understanding the effect of monitoring.

Figure 16. Stages of the research project



4.3.1 Method used to answer the first research question: How can Public Service Information (PSI) materials be classified in terms of User Experience?

4.3.2 Sample for first research question

This study adopts a cross-sectional approach in order to analyze Public Service Information materials provided to the Chilean school system by the Agency. The portfolio of PSI materials covers a range of stakeholders (see Appendix G). The information products included in the sample for this study were those designed and produced for use by school communities in order to improve the quality of education. Such items correspond to the figure of Government-to-Citizen (or G2C) information, as described by Linders (2012). In general, these PSI products look to aid the decision-making process and provide knowledge of best practices in the classroom and at school-management level. The main sources of these PSI products included:

a) the Agency's main website (www.agenciaeducacion.cl)

b) the Agency's social media site (https://www.facebook.com/Agenciaeducacion/)

Both sources provide school communities with access to general documentation and specific reports regarding the performance of their school. Each of the information products selected for this study was downloaded and assessed by a member of the Agency and two members of the research team. The aim of doing so was to validate whether the information specifically targeted the school community, as well as to confirm that it was both up-to-date and available for general access. Following this, each PSI product was then characterized in terms of its format (Batley, 2007) (Table 28).

Table 28. Sample of PSI materials initially selected for the study

N°	Format of PSI	N
1	Brochure	4
2	Infographic	8
3	Video	5
4	Document	21
5	Presentation	8
6	Banner	9
7	Calendar	2
	TOTAL	57

4.3.3 Definition of dimensions for classifying UX

Each of the PSI products in the sample was examined in order to define the dimensions that could then be used to classify the User Experience. In addition to their format, we were also able to distinguish between the products based on the intrinsic quality of the content. In this case, the intrinsic quality was directly related to assuring the quality of the education process. Based on this, the first dimension was defined as the "interaction goal" of the information product. This objective is understood to be *"the experiential feature defined by the*

information provider in order to match the core process of the public service". Table 29 shows a set of eight objectives that were defined by the research team based on their analysis of the fifty-seven PSI materials included in the sample.

Table 29. Interaction goals

N°	Interaction Goal	Definition
1	Invite	Provide an invitation to internalize and/or participate in a process, event organized by the public service
2	Understand	Help the user understand the main concepts of the process delivered by the public service
3	Plan	Provide the user with resources to organize their actions over time in order to meet the public service's main goal
4	Communicate with others	Help the user transmit information to other users
5	Engage	Generate a positive link with the user that encourages them to take certain subsequent actions
6	Assess	Allow an understanding of how the same type of data evolves over time
7	Guide	Provide a guide that allows the user to make decisions, as well as to understand the deadlines and stages of a process
8	Diagnose	Provide the user with information regarding the current status of certain variables

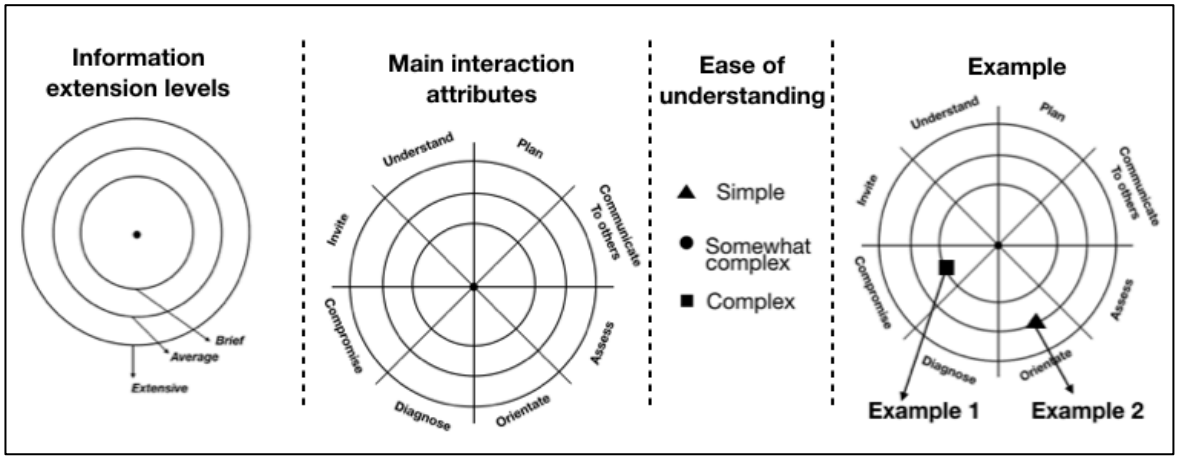
As the interaction goal only addressed intrinsic qualities of the information product, further insights were required in order to address the contextual and representational dimensions (Michnik & Lo, 2007). User Experience can be viewed as the process of gaining retrospect on current knowledge, feelings and assessments (Hassenzahl, 2008). On-site visits were therefore conducted in order to learn more about the context and to observe the teachers' and

principals' daily workflow when using government information. These on-site visits then helped define two further dimensions for classifying User Experience:

- Volume of Information (Contextual quality): In general, school principals and educators are very busy people. Consequently, any additional information must quickly meet their needs and solve the task at hand. Based on Martin et al. (2017), this attribute is related to *"the degree to which an information product has an appropriate amount of content in order to effectively accomplish a task"*.
- Ease of Understanding (Representational quality): In order to understand and act effectively, the information must be tailored to match the users' previous experience. Based on Wang (2008), this dimension is defined as *"the degree to which users need to recall previous knowledge in order to understand the content of the information product"*

For an initial classification of the Public Service Information and in order to understand the initial findings, the research team developed a graphical representation of the three aforementioned dimensions of UX. The representation that was selected was based on a coordinate system so as to provide a quick overview of the information (North & Shneiderman, 2000). The first dimension (Volume of Information) is displayed as three concentric circles, with the circular area then divided into 8 sections (Figure 14). Each section is labeled with the main interaction goals. Finally, the Ease of Understanding dimension is represented using three different shapes. These shapes are placed in the circles, with each one representing a different information product.

Figure 17. Graphical representation for classifying PSI



Two example information products are classified in Figure 14, Example 1 represents a brief yet complex product associated with the interaction goal 'Engage'. In this case it could be a brochure explaining a new aspect of quality assessment that schools will be required to report on by sending certain documents through to the Agency. Example 2 represents an average-length, easy to understand product that looks to guide school principals. This might be a report of the school's performance, including guidance on how to improve their processes and the quality of education. Finally, the sample of fifty-seven existing PSI materials was organized according to the three dimensions described above (main interaction goal, volume of information and ease of understanding).

4.3.4 Method used to answer the second research question: How can the User Experience of PSI be monitored over time in order to inform design decisions?

4.3.5 Survey design: Dimensions for assessing User Experience

As described previously, the method for classifying PSI was based on three main dimensions (Volume of Information, Interaction Goals and Ease of Understanding). These were displayed graphically, as shown in Figure 14. The research team then decided it would be useful to use these same three dimensions when designing the User Experience survey. By doing so, a comparison could be made between the organization's perception of their PSI materials and the users' response. Furthermore, based on the recommendations of the head of the Agency's Information Division, two additional dimensions were added to the monitoring process. These recommendations were based on previous studies conducted by the agency in order to understand Usability and Information Quality. Table 30 summarizes the dimensions that had been assessed previously by an external consulting firm through an *"Assessment of Information Products"* (2016**)** and the *"School Principals Survey"* conducted by the Agency's Studies Division. To understand how these studies relate to previous UX theory, each question statement was related to one of the Usability dimensions (Learnability, Efficiency, Memorability, Errors or Satisfaction) defined by Nielsen (1993) and to the Information Quality framework proposed by Wang and Strong (1996).

Table 30. Summary of main factors for assessing UX taken from previous studies for a given PSI

N°	Question statement	Usability dimension	Information Quality dimension	Source
1	Please rate: Clarity with which the PSI is described	Learnability	Intrinsic	External Consulting Firm
2	Please rate: Usefulness of information for making strategic decisions for your school	Efficiency	Contextual	External Consulting Firm
3	Please rate: Clarity of how results are presented to your school	Learnability	Intrinsic	External Consulting Firm
4	Please rate: The usefulness of contents for pedagogical decisions	Efficiency	Contextual	External Consulting Firm
5	Please rate: General clarity of information	Learnability	Intrinsic	External Consulting Firm
6	How does the relevance of this PSI compare to other PSI products delivered to your school?	Efficiency	Contextual	External Consulting Firm
7	How would you consider the length of the information product?	Efficiency	Intrinsic	External Consulting Firm
8	How useful have you found the data provided for your school in recent years?	Efficiency	Contextual	Internal Survey to School Principals

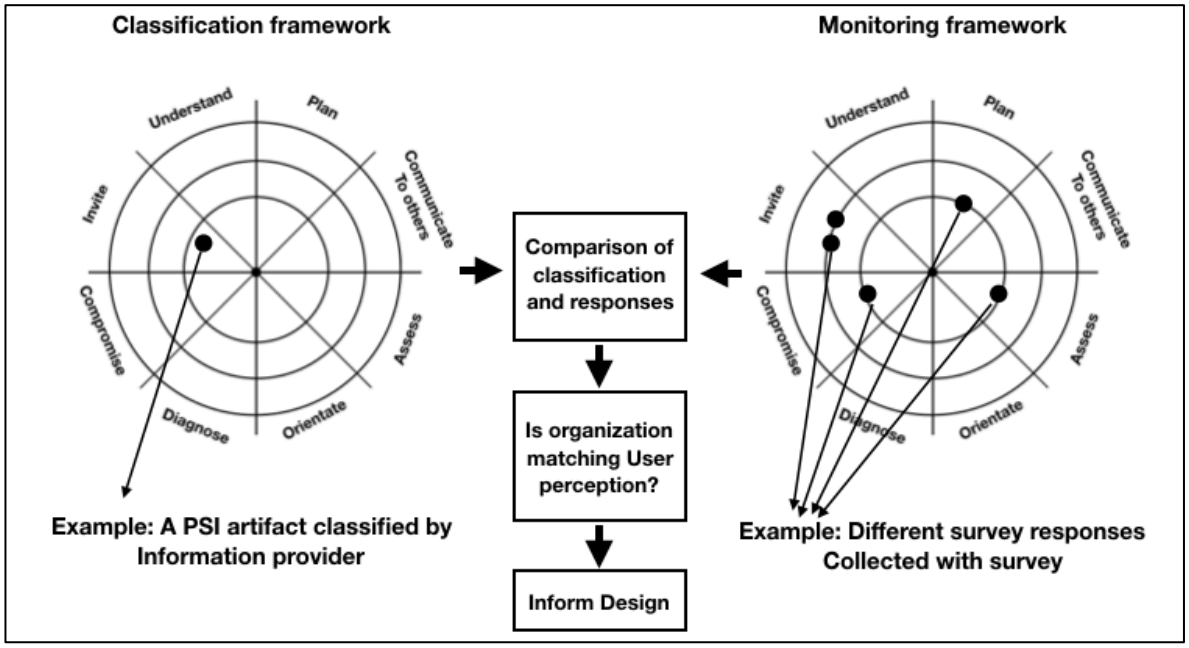
9	Please indicate the medium through which you receive the information provided by the Quality in Education Agency	Satisfaction	Accessibility	Internal Survey to School Principals
10	Please indicate which information you have had access to	Satisfaction	Accessibility	Internal Survey to School Principals

Table 30 provides an overview of the main factors that were considered by the Agency when assessing Usability and Information Quality. These mostly relate to the intrinsic or contextual dimensions (4 factors each), followed by accessibility (2 factors). Following this analysis, the research team proposed a set of five questions to cover every dimension of the User Experience with PSI. In order to do so, five contextual qualities were taken into account:

- Interaction Goal: What is the main goal of the interaction for the users?
- Volume of Information: How much information is included in the information product?
- Ease of Understanding: How complex do users find the information product to be?
- Findability: How easy is it to find the information that is needed?
- Usefulness of information: How useful is the information for making decisions regarding quality management in education?

Figure 15 summarizes the connection between the classification, monitoring and design processes within the Agency's Information Division.

Figure 18. Model for the classification, monitoring and design processes



In this sense, the first step would be to classify an information product according to the three dimensions of User Experience. Following this, a survey is sent out based on the same three dimensions. With the users' responses, the information provider is able to compare their own classification with the users' general perception and therefore assess whether they are aligned. Based on this analysis, the model can be used to inform design decisions. For example, an information product where the organization's classification matches the users' perception would suggest that the design features are valuable and that the information is being transmitted in the way the provider had intended. In contrast, an information product where the organization's classification does not match the users' perception may have to be redesigned.

Table 31 provides a summary of the dimensions included in the survey that was sent to the school principals. The table shows the dimensions of User Experience that were assessed, as well as the questions included on the survey and the possible responses.

Table 31. Summary of User Experience dimensions covered by the survey

N°	User Experience Dimension	Question statement	Response options	Information Quality dimension
1	Interaction Goal	This product is useful for:	Informing: it gives information about developments in education Guiding: it gives practical information for you to use Introducing: it explains new concepts and approaches	Intrinsic
2	Volume of Information	The length of the product seems:	Brief Average Extensive	Contextual
3	Ease of Understanding	In terms of complexity, the information is:	Simple Somewhat complex Very complex	Representational
4	Findability	Finding the information I need is:	Easy Quite easy Hard	Contextual
5	Usefulness	The content seems:	Useful Somewhat useful Very useful	Contextual

The aim of the survey outlined in Table 31 was to provide the Agency's information managers and designers with a general tool that could be applied to a wide range of

information products. Three of the four dimensions of information quality are covered, with only accessibility left out. This was because accessibility was considered to be related to the channel through which the information was delivered, more than the design and content itself. This survey was then used in Stage 3 of the study (Figure 13).

4.3.6 Sample for second research question

The research team selected a specific PSI product to test the initial model (Figure 15) and monitor the User Experience. The item that was selected was a document called the *Results Report for School Principals and Teachers*. This is the most important information product that is delivered to the Chilean school system by the Agency. The report is customized to include the standardized test scores for each school. It also provides a comparison of their test scores with similar schools in the same geographical area. A physical copy of the report is sent to every school in the country in April of the year after students take the national standardized tests. Every school principal can then also access the report at any time by logging on to Agency website. Table 32 summarizes the two assessments of User Experience that were carried out.

Table 32. Summary of the assessment of User Experience for a given PSI product

PSI assessed	Date issued	Assessment date	Survey sample size	Responses
2015 National Quality Test Score Report for School Principals	April 2016	November 2016	1,000	338
2016 National Quality Test Score Report for School Principals	April 2017	May 2017	1,000	298

On both occasions, the same PSI survey was sent to a random sample of 1,000 school principals using an ICT platform built for this purpose. No principal received the survey twice. A reminder email was sent after a week to any principals who had not answered the survey (for specific details of the assessment process, see (Author, 2017)). A t-test was performed on the proportion of responses for each question. The aim of this was to verify whether there were any changes in the users' perceptions between one assessment and the other.

4.3.7 Focus group design

Historically, the Agency assessed its information products by hiring external consultants. However, monitoring requires constant assessment over time and the research team was also looking to install the process within the agency in the medium term. The research team therefore anticipated potential barriers or challenges when it came to effectively implementing this process within the Agency's PSI team. Given this, a focus group was set up to identify aspects that might encouraga or discourage implementation of a method for monitoring User Experience. This approach was chosen given its anticipatory nature and capacity for contextual deliberation (Macnaghten, 2017).

The focus group methodology considered the following aspects:

- Agreement: At the beginning of the session, each participant signed a document detailing: 1) the goal of the study, the implications of participating and how the data from the session would be used; and, 2) signed consent to allow the research team to record the session for subsequent transcription and coding.

- Participants: Eight full-time professionals from the Agency's Information Division participated on a voluntary basis. On average, they had 6.8 years of experience in terms of Information Design activities, allowing them to be classified as experts. For detailed information of the sample see Appendix H.
- Objective: Study how the participants relate to the issue of information design and user assessment of PSI products, as well as how they would (or would not) adopt a tool for classifying and monitoring User Experience.
- Location: The study took place in the Agency's central offices.
- Duration: the focus group lasted for a total of 90 minutes.
- Framing: The lead researcher gave a 20-minute opening presentation. The objective of this was to: 1) ensure a shared understanding of what is meant by E-government, User Experience and Usability, 2) show the results from previous user studies organized by the Agency in order to understand which usage dimensions have been studied before, and 3) show the results of the initial classification and first survey sent to 1,000 school principals (Stage 3 in Figure 13).
- Discussion: Table 33 summarizes each of the statements that served as the topics of discussion. These were based on the framework developed by Kieffer & Vanderdonckt (2016) for understanding user-centered maturity levels within an organization. The eight statements were displayed and read aloud by the moderator. After each statement was shared, the group were given five minutes to reflect and give their opinions.

Table 33. Focus group statements

Nº	Statement	Aspect
1	*User studies are not a concern for us*	Organizational
2	*User studies are used from time to time in some projects*	Organizational
3	*User studies are promoted internally and externally*	Organizational
4	*Usability is taken into account when making strategic decisions*	Organizational
5	*There is a lack of experience, methods and tools*	Methodological
6	*Difficulty accessing users*	Methodological
7	*Low integration with the design process or product development*	Methodological
8	*Usability benefits are scarcely highlighted*	Methodological

- Data Collection: The audio for the entire session was recorded and then transcribed by the research team.
- Analysis and Interpretation: Each of the participants' statements was coded based on the dimensions proposed by Kiefer and Vanderdonkt (2016) and social content analysis (Miles & Huberman, 1994). The coding structure that was followed is summarized in Table 34.

Table 34. Structure for coding participants' statements

Code	Dimension	Definition	Value
UA	User Awareness	Statements related to user-centered studies and/or processes within the organization, understanding	1: Lack of User Awareness: Indifference towards user assessment or participation 2: Partial User Awareness: Underestimating the benefits of user-centered processes when producing information
E	Expertise	Statements related to the level of knowledge regarding user studies and/or user	1: No expertise: No focus on users, product or technology-driven methodologies for producing information

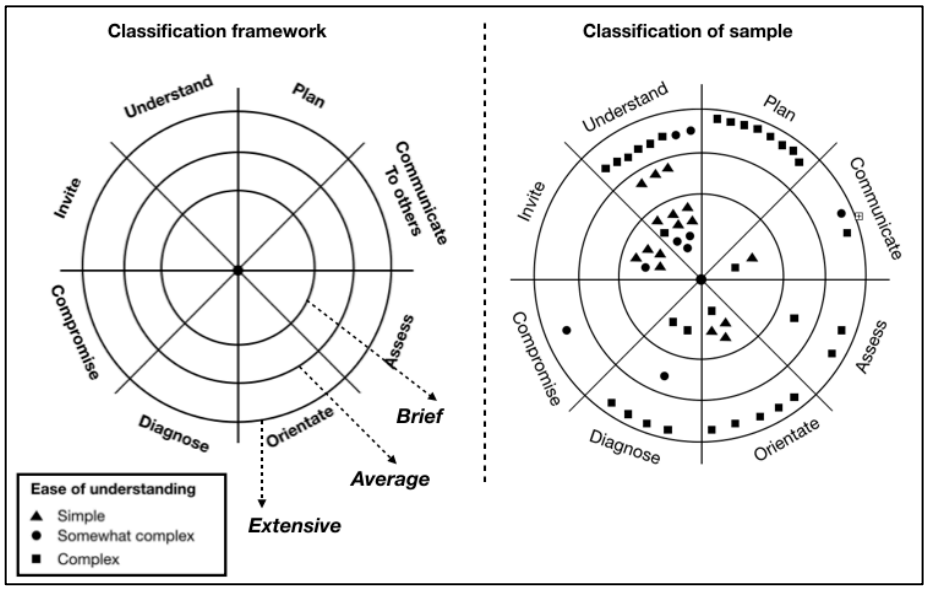
		participation in the organization process	2: Partial: User-centered methods, acknowledging users and/or user-studies as key elements of the process 3: Expertise: User-driven methods, use of full range of techniques for user assessment
R	Resources	Statements related to items such as budget, staff and facilities for conducting user studies	1: No resources: no budget, lack of tools and/or little/no staff for conducting user studies 2: Limited: budget for a few selected user-centered projects, limited tools and space available for user studies 3: Intensive: Budget available for any on-going project, testing lab, equipment and/or technologies
M	Management	Statements related to issues regarding: schedule, funding, promotion, project management and access to users	1: Ad hoc: Poor access to users, occasional access during a few projects, decisions mostly based on personal judgement 2: Proactive: sporadic access to users, included as part the project, measurement of key aspects 3: Continuous: Drives development, monitoring of key aspects
A	Attitudes	Statements about attitudes towards user studies and or user-centered processes involving intra-team resistance to change vs internal/external promotion	1: Not a concern: User studies should be the concern of other organizations and/or outside agents 2: Acknowledgement: Limited promotion and support from decision-makers, internal resistance to adopting user-centered processes, despite acknowledging the benefits 3: User-centered culture: Promoted internally and externally, drives strategy, embedded in the organization's culture

4.4 Results

4.4.1 PSI-Classification

Based on the graphical representation framework and model (described in the Research Method section), the sample of fifty-seven information products currently in use were classified and displayed by the research team (Figure 16).

Figure 19. Classification of a sample of PSI materials. N.B., there are fewer than 57 items included in the model as many of these were duplicated.



The results from the model in Figure 16 reveal the following:

- Main interaction goals: 52.7% of Public Service Information materials aim to guide or help users understand certain concepts.
- Volume of information: 52.6% of the materials in the sample are considered extensive, followed by 8.8% that are considered Average-length, and 38.6% that are considered brief.
- Ease of understanding: 28% of the materials are easy to understand, 15.8% are considered somewhat complex and 56.2% are considered complex.

4.4.2 Validating and redefining the main interaction goals

This initial representation of the PSI portfolio was validated with the head of the Information Division and the members of staff responsible for designing the main information products. The validation process led to the following conclusions:

- The 8 interaction goals are helpful and provide an overall assessment of the User Experience within the school community. However there is a need for these to be aligned with the Agency's own internal processes.
- Focusing on school principals is key as their level of interaction and User Experience is essential for driving change as part of the school's quality management process.

Following the action research approach and based on the recommendations of the head of the Agency's Information Division, a second iteration of the classification method was then developed by the research team. The eight interaction goals were reduced to three (Table 35). In this sense, 'Introduce' refers to information products that look to explain different aspects of the quality assessment and quality management process in schools. The other two goals, Guide and Inform, were designed to be aligned with the Agency's mission statement (http://www.agenciaeducacion.cl/nosotros/quienes-somos/).

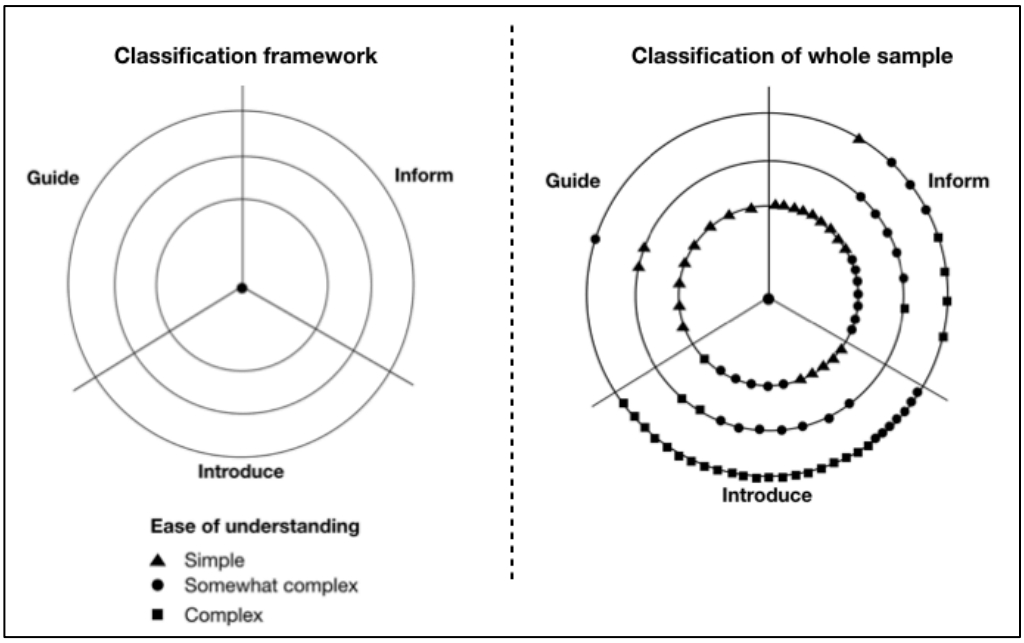
Table 35. Redefining the main interaction goals

N°	Main interaction goals	Definition
1	Introduce	The goal of the information is to provide users with conceptual knowledge of the range of actions taken by the agency. This is mainly achieved by explaining different methodologies and concepts relating to the quality assessment and quality management process in education.

2	Guide	The goal is to provide users with specific guidance regarding the implementation of improvement plans in schools, both on a strategic and classroom level.
3	Inform	The information product aims to provide the user with information of contextual issues: policy-making, events, education.

Figure 17 shows the new classification framework based on these three main interaction goals. With the second iteration of the framework, the PSI portfolio increased from fifty-seven to eight-nine items. This is because new materials had been published since the initial classification framework was developed.

Figure 20. Redefining the classification model. N.B., there are fewer than 89 items included in the model as many of these were duplicated.

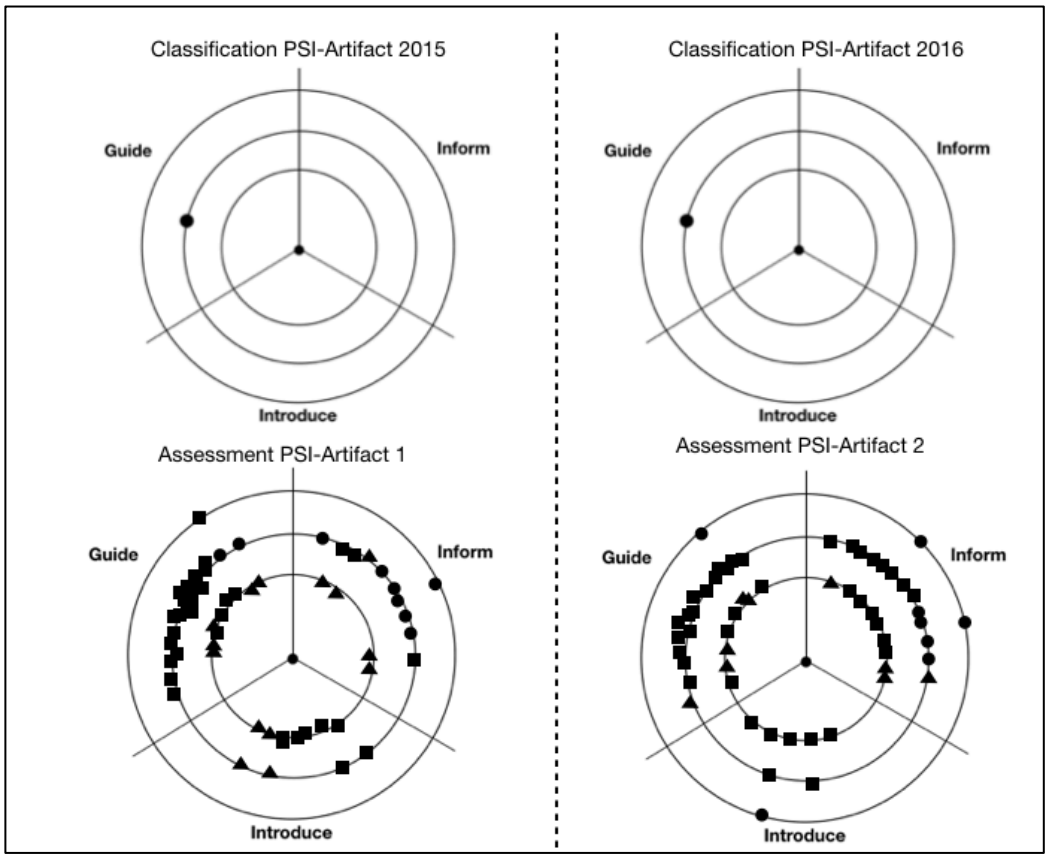


The results from the model in Figure 17 reveal the following:

- Main interaction goals: The goal of 48 of the items (53%) was to Introduce, while for 30 of the items (33.7%) it was to Inform and for 11 (12.4%) it was to guide.
- Volume of information: 42% of the items from the sample are considered extensive, while 19% are considered average-length and 39% are considered to be brief.
- Ease of understanding: 36 of the items (40.4%) were categorized as somewhat complex, 28 (31.4%) were categorized as simple and 25 items (28.2%) were categorized as complex. 4.4.3 Assessing User Experience

The 2015 and 2016 Results Report for School Principals and Teachers were classified by the Agency team using the framework shown in Figure 15. The Agency team considered there were no significant differences in the design of the two reports. In that sense, they were both classified as average-length, yet complex, documents that look to 'guide' the user. Figure 18 shows the initial classification made by the Agency's Information Division, as well as the results from the User Experience survey that was answered by school principals in November 2016 and May 2017, respectively.

Figure 21. Classification and survey results for 2015 and 2016 Results Report for School Principals and Teachers



Following classification of the report by members of the Agency's Information Division, two surveys were sent out to a sample of 1,000 school principals in November 2016 and May 2017. The purpose of these surveys was to ask the users (the school principals) for their view of each report. The main goal of this was to test the survey (defined in Section 2.2) and provide the Agency's information design team with feedback from the school community. There were no significant differences in the design of the two information products (the 2015 and 2016 Results Report for School Principals and Teachers). It was therefore reasonable to expect that the assessment of the User Experience would not differ significantly from one year to another. Indeed, Table 36 shows that there were no statistically significant differences

when comparing the percentages of each response to the five questions on the survey. The response rate for the first survey was 33.8% (N=338) for the first iteration and 29.8% (N=298) for the second (Table 36).

Table 36. Summary of responses to the questions on the survey

Extension		Extensive	Average	Brief
N=338	2015	21,3	73,4	5,3
N=298	2016	16,4	78,9	4,7
	T-test	t(634)=1.572	t(634)=1.620	t(634)=0.346
	p-value	p=0.116	p=0.105	p=0.729
Usefulness		Very Useful	Somewhat useful	Not very Useful
	2015	75,7	21,9	2,4
	2016	80,5	18,5	1,0
	T-test	t(634)=1.457	t(634)=1.064	t(634)=0.1346
	p-value	p=0.145	p=0.287	p=0.178
Interaction attribute		Guide	Inform	Introduce
	2015	79,6	16,6	3,8
	2016	80,9	15,4	3,7
	T-test	t(634)=0.411	t(634)=0.412	t(634)=0.066
	p-value	p=0.681	p=0.680	p=0.947
Understandability		Simple	Somewhat complex	Very Complex
	2015	71,9	26,3	1,8
	2016	70,1	27,5	2,3
	T-test	t(634)=0.499	t(634)=0.341	t(634)=0.446
	p-value	p=0.617	p=0.733	p=0.655
Findability		Easy	Moderately easy	Hard
	2015	62,1	35,8	2,1
	2016	60,1	38,6	1,3
	T-test	t(634)=0.516	t(634)=0.729	t(634)=0.773
	p-value	p=0.605	p=0.466	p=0.439

The Agency's team was able to identify the following aspects of the two information products that were assessed (Figure 18):

- The majority of the assessments (79.6% & 80.9%, respectively on each survey) coincide with the Agency's initial assessment and classification of both reports as a document to 'guide' the user.
- The second most popular response in this sense suggested that the document aimed to 'inform' the users (16.6% and 15.4%, respectively on each survey). This can be

interpreted as being a group of users who read the document simply to inform themselves of their score on the National Quality Test (SIMCE), without fully appreciating the recommendations made by the Agency.

- The agency classified both reports as being "average" in length, which coincides with the majority of users (73.4% and 78.9 %, respectively on each survey)
- In terms of "ease of understanding", the Agency classified both reports as being "somewhat complex". However, only 26.3% & 27.5% of the users who were surveyed agreed. In contrast, 71.9 % and 70.1 % of users considered the document to be "simple". Based on the team's analysis, this probably suggests that users do not read the document thoroughly, instead covering only the basics (score and trends).

4.4.4 Focus group results

As described in section 2.2.3, a focus group was held in order to understand how the team from the Information Division relate to issues of information design and user assessment of information products. The focus group also provided an opportunity to understand how the team would (or would not) adopt a tool for classifying and monitoring User Experience. The results from the coding of 37 statements made by members of the focus group are shown in Table 37.

Table 37. Summary of the statements made during the focus group

Dimension	Nº Statements	% of total	Value 1	Value 2	Value 3	Total
User Awareness	7	18,9	Lack	Partial	Complete	
			0	14,29	85,71	100,0
Expertise	3	8,1	No expertise	Partial	Expertise	
			0	100	0	100,0
Resources	12	32,4	No resources	Limited	Intensive	
			8,3	91,7	0	100,0
Management	11	29,7	Ad hoc	Proactive	Continous	
			45,5	54,5	0	100,0
Attitude	4	10,8	Not a concern	Recognition	User centric	
			25	75	0	100,0
Total	37	100,0				

The topics that came up most often during the focus group were Resources and Management, followed by User Awareness. In the case of the latter, it was a common concern within the design process (i.e. there was 'complete' user awareness). However, when referring to resources, 91.7% of the time it was to talk about 'limited' resources. This suggests that there is a general concern regarding the implementation of user studies. In this sense, it is important for any initiative involving UX monitoring to fit within the annual budget. In terms of Management, there was little agreement as 54.5% of responses suggested that management of user-centered processes was 'proactive', while 45.5% suggested it was 'ad hoc'. In general, user-centered monitoring processes are only conducted by the Agency when time allows.

4.5 Discussion, Conclusions, Limitations and Future Work

The public sector has evolved to become the largest information provider (Bountouri, 2010). Consequently, Public Service Information in the context of e-government has become increasingly complex, particularly considering the citizens' previous experience (Mouzakitis et al., 2017; Henninger, 2017). However, increased access to integrated content and data does not necessarily lead to increased levels of satisfaction, efficiency and/or effectiveness when it comes to solving tasks involving PSI (United Nations, 2016). Many of the strategies used to manage, design and produce public information still lack the resources and expertise that are needed in order to base decisions on user-centered studies and/or processes (Thorsby et al., 2017; Verdegem, 2009). Public services must be able to meet the demand for improved levels of User Experience if they are to close the gap between the goals they set as information providers and the goals of their citizens (Henninger, 2017). The present study therefore aims to provide a model for classifying and assessing Public Service Information from a user-centered perspective. The purpose of this is to provide information designers and managers with a conceptual framework and practical tools for improving the effectiveness of their government-to-citizen information.

Our first research question asked "How can Public Service Information materials be classified (or grouped) in terms of User Experience?" Most models in the literature include three or four dimensions for understanding PSI materials (Lakomaa and Kallberg, 2013; Linders 2012; Kalampokis, 2011). Our three dimensions (Volume of Information, Main Interaction Goals and Ease of Understanding) may therefore reflect a trend towards

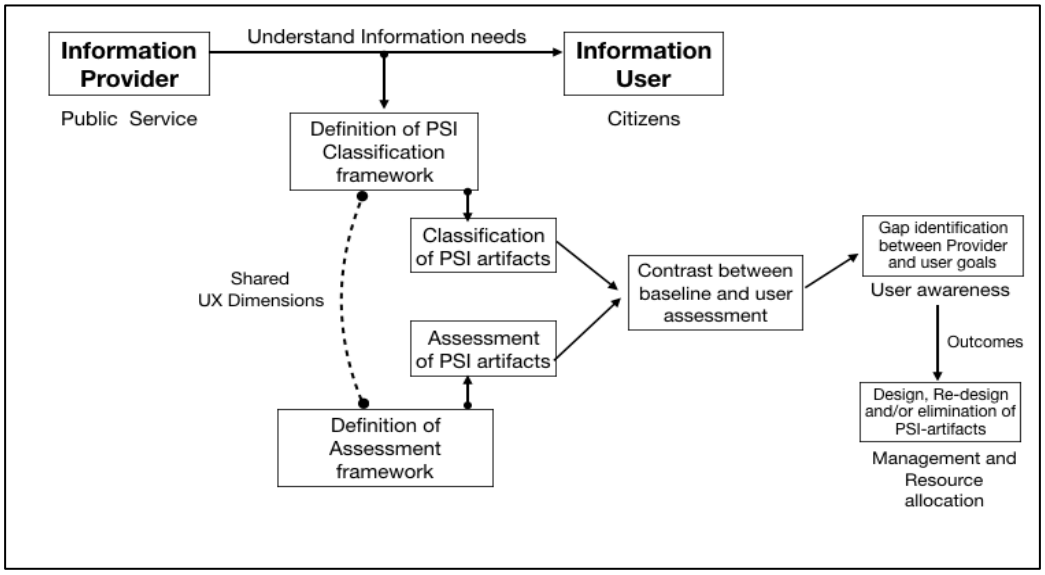
simplicity, by grouping similar attributes as a single dimension. The classification of User Experience also revealed the complexity and variety of the information products managed by the Agency. In this sense, by having to assess and position the information products on a graph, the Agency had more visibility of the items they produce. This is in line with the concept of a "directory of understanding" (Stohl et al., 2016), which is linked to the idea of building classification schemas of data and information. Doing so allows other users to easily access and acquire the information that they need.

The classification itself revealed that the majority of the information products are in line with the organization's core mission (i.e. 2 of the 3 dimensions form part of the Agency's mission statement). This can be interpreted in two ways. On the one hand, it may suggest a tendency to strengthen areas that fit with the Agency's agenda. Doing so facilitates the internal decision-making process, as well as optimizing the allocation of resources. This is particularly important when considering that UX assessment is a new process that needs to be added to the existing workflow. This would be in line with previous studies, which have shown that institutional factors can influence content production (Mahler & Regan, 2007). On the other hand, it may reflect the increased value of User Awareness within the team responsible for information design. This was seen during the focus group, where the participants frequently discussed the importance of understanding what school communities needed from the information provided by the Agency. This is in line with a general trend towards user-centered approaches in e-government (Verdegem & Verleye, 2009), where satisfaction surveys look to match the citizens' needs with the interaction goals of the information that is provided.

Our second research question explored how the User Experience of PSI can be monitored over time in order to inform design decisions. In this sense, our study involved a system in which an information product is assessed independently and integrated into a mutual framework. Such a system can provide points of comparison that can then be used to understand the User Experience. This is in line with the idea of User Experience and Usability as a recurring process of evaluation, rather than as a single snapshot (de Róiste, 2013). Using a standard chart for assessing User Experience also brings a level of consistency to the monitoring process. This is in line with the recommendation by Throsby et al. (2017) to track data using similar and consistent tools. We found that monitoring the User Experience of a specific product (National Standardized Test Report) allowed for a better understanding of the users' attitudes towards e-participation and the use of public information. This was based on an analysis of the school principals' responses to the survey questions. This is in line with the theory that contextual factors should be taken into account when assessing information (Ghasemaghaei & Hassanein, 2015). This theory suggests that the timely delivery of information has a positive impact on the way citizens use information when completing a task. Furthermore, the focus group involving members of the Agency's Information Division showed that Management and Resources are the team's main concerns when it comes to implementing user-centered processes within the organization. This is linked to the fact that continuous testing and assessment of information requires higher levels of resources and support from decision-makers, as suggested by Kieffer & Vanderdonckt (2016). Finally, this study provides a model that integrates the classification and assessment of Public Service Information materials. This is made possible by using the same dimensions

to classify and assess User Experience. The initial classification by the members of the Information Division allows the organization to do a self-assessment of the UX for a given information product. Doing so establishes an initial 'baseline' assessment. Contrasting this baseline with the results of the user assessment will help organizations better understand the communication gap between the information provider (public service) and the users (citizens). The model for monitoring user experience is shown in Figure 19. We believe that the importance of this study relates to the impact it may have on public institutions when it comes to objectively evaluating their existing PSI portfolio. Doing so will then help them to redesign their information products in order to close the gap between the institution's goals and the needs of the citizens.

Figure 22. Final model for classifying PSI and assessing User Experience



In terms of limitations, this study was carried out in a very specific context (i.e. using the 2015 and 2016 Results Report for School Principals and Teachers produced by Chile's

Quality in Education Agency). These reports obviously relate to a very specific set of users. Future studies should therefore look to apply the classification and assessment model to other government agencies, with different missions and different audiences. Further research is also required in order to understand how applying the model described in Figure 19 may influence attitudes towards user-centered processes in relation to the design and implementation of Public Service Information.

5. RESEARCH LIMITATIONS, CONCLUSIONS AND FUTURE WORK

5.1 Research Limitations

Despite the results obtained in this thesis which provide evidence to suggest that User Experience assessments mechanisms provide support to enhance the quality of service between the defined actors (public agencies, educational institutions, students and their families), it is possible to identify limitations of the overall process:

a) All of the studies were conducted with regards to the Quality in Education system of Chile, a system with less than a decade of implementation, where the different actors are still experiencing difficulties with regards to what it means to actively participate in the assurance and enhancement of quality. It is important to note that this is a limited context. In order to better generalize the results, studies would have to be conducted including information artifacts in all of the spaces of interaction between actors (Figure 5). Particularly this thesis did not cover interactions in the guidance space. In the case of Chile, a major role in this space is represented by the Superintendence of Education.

b) Furthermore, all of the studies in this thesis were conducted with regards to assess the User Experience of Information Artifacts with low level of interactivity (Reports and Learning Materials). However, it would be necessary to assess and monitor also medium and high interactivity artifacts in order to provide a general perspective of the outcome over the service quality.

c) Due to time and implementation constraints, it was not possible to develop improvements to the prototype in order to enhance its use by agency professionals. For example, a prototype with user-feedback features could better inform the type of design-decisions taken by the Agency after monitoring User Experience. In consequence, a new iteration of the prototype should allow to understand if user-centered practices effectively affect the organization and internal decision-making.

d) One of the grounding idea of this research is that enhancement of User Experience monitoring of all types of information artifact can lead to a balanced Quality of Service in any of the interactions between agents (e.g. Regulatory, Performance and Guidance interaction spaces depicted in Figure 5). However, the research was not able to cover extensively all the products involved in the Chilean Quality of Education System, due to time constraints.

5.2 Conclusions

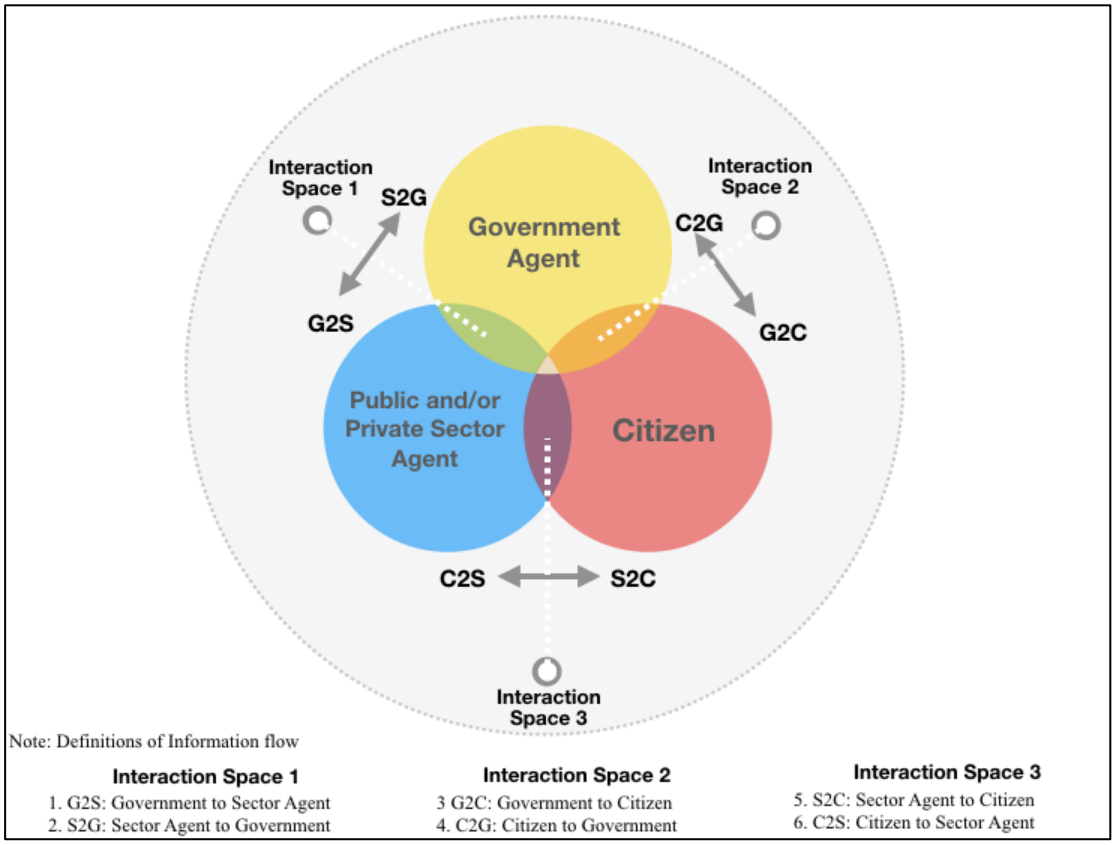
This thesis aimed to understand how the Quality of a Service (either governmental, educational or student guidance) could be improved by continuous monitoring of User Experience. This thesis contributed to the literature by generating a model in which the information provider and information user are strongly linked over a common interaction space (in our case: Quality in Education, with regulatory, performance and guidance spaces). Different dimensions of User Experience, Usability and Information Quality were integrated to a user surveying tool, which is easy and simple to apply and analyze. The economy of resources when employing a user-centered method is relevant. Traditionally user centered design and evaluation has been a costly process within organizations, particularly when

measurement is performed in the long-term (Kujala et al, 2011). Additionally, User Experience assessment is usually misunderstood with regards to organizational strategic goals, even though User Experience practitioners themselves perceive that UX may help *"design better products"* (Lallemand, Gronier & Koenig, 2015)

The definition of a general context in terms of information agents and interaction spaces between them (as displayed in Chapter 1, Figure 5), allows for contextualization of information artifacts across variety of decision-making processes. For example, the Quality Assessment Report delivered by the Quality in Education agency not only establishes goals and planning at administrative level, but also has a significant effect over planning in the school in terms of teaching and learning goals. Therefore, this thesis demonstrates the need to define primarily a general context of information flow (Figure 23) in order to be able to provide a greater perspective to the User Experience assessment results of particular information artifacts within a system of agents (Government, Public/Private Sector Agents and Citizen). This perspective can be applied to other domains of study, such as:

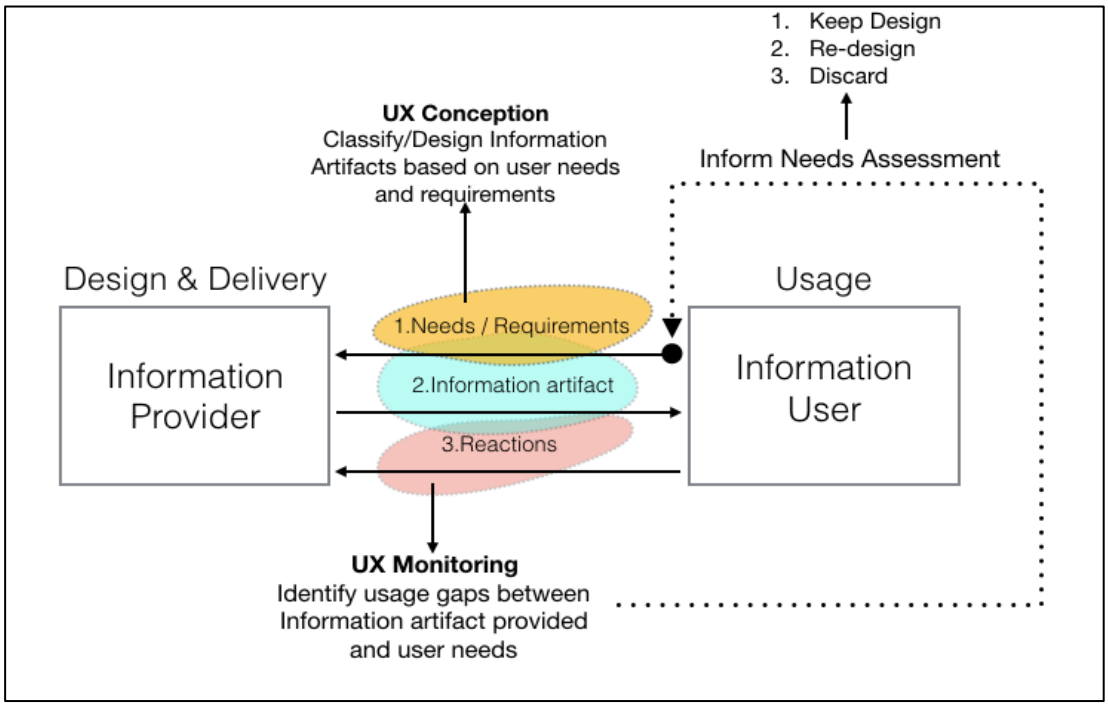
- Public Health: Government agent > Superintendence of Health / Public Sector Agent > Hospitals / Citizens > Public Health Patients.
- Public Finance: Government > Central Bank / Private Sector Agents > Banks and Pension Companies / Citizens > Private banking clients.
- Energy regulation: Government > Ministry of Energy / Private Sector Agent > Electricity Distribution Company / Citizen > Electric energy clients.

Figure 23. A general perspective over agents and information flow for government-based information



Furthermore, a sender-receiver modelling provides a sound basis for understanding the central role of an information provider with regards to the Quality of Service. In Figure 24, User Experience monitoring is generalized with regards to a three-way model of interaction. The primary effect of monitoring usage is to make design decisions over time in order to enhance overall the Quality of Service. Information artifacts after assessment should either be redesigned, maintained, discarded or be an open space for designing new solutions based on user needs.

Figure 24. Quality of Service based on the three-way model between information provider an information user



Also, a constitutive research conclusion is related to the need that organizations need to approach User Experience of their information artifacts considering both the system provision system and the system content. In view that most studies relating to Educational or Government artifacts for education are closely focused on interactive nature, we conclude that the path towards Quality of Service should assess all the ranges of interactivity.

Finally, this thesis used action-research as method, which sets at the core of the process a strong collaboration between the participants of the research team. In this case, we partnered up with professionals of Quality in Education Agency, with representatives of the Engineering School student center and with instructors of Engineering courses. The degree to which these interactions were significant, relate to the research results obtained. In

consequence, it is possible to state that the use of action-research was an adequate method to the research problem and context. This method allowed primarily to focus correctly on the real problems that information providers where facing, and therefore allowed to correctly understand the needs regarding User Experience Monitoring.

5.3 Future work

The experimental results obtained from this thesis are valid for the context in which the studies were implemented. In the regulatory space, our results relate to Chilean Quality in Education system, with one particular public agency (Quality in education Agency) and with regards to the User Experience assessment in the performance space, we were able to cover Higher Education students (particularly, engineering students). Furthermore, agencies of the Quality in Education system and information users should be included progressively in order to acquire a complete perspective of the Quality of Service over all the interaction spaces (regulatory, performance and guidance). Future work should also explore the entire spectrum of interactions defined, particularly: student to government (S2G), government to student (G2S) and Educational institutions to Government (E2G).

Effectively monitoring information artifacts over a complex system of actors and interactions is not only a complex task; it also requires a long period of assessment in order to reach robust and generalizable conclusions. The study described in Chapter 5 was set in two specific times of the year. At the end of the second semester which coincides with the end of the school year and at the end of the first semester. Therefore, we were able to monitor the Quality Assessment Report two times, contrasting results for different samples of

respondents. However, the first User Experience assessment was made after six months of delivering these reports into the school system. The second User Experience assessment was made after one month of delivering the report. Further analysis of when the assessment should be made with regards to the time elapsed between information provision to consultation should be included in future work.

Also, survey tools for information artifacts delivered in face to face (e.g. seminar) events have been suggested to be useful in the future by agency professionals. This type of interaction may also allow to observe any differences on how the perception of an Information Artifact is assessed when there´s a human component in the transmission of content.

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APPENDIX

Appendix A: Survey for Stage 3

1. Podcast Survey

With regards to the Podcast, please respond to the following statements:

1. The Podcast was**:**
- Too short
- Adequate in length
- Too long

2. Which purpose did you feel the Podcast served?:
- Learning how to apply knowledge to a professional context
- Preparing for a test
- Both of the above
- Don't know

3. The Podcast was:
- Easy to understand
- Fairly understandable
- Hard to understand

4. The Podcast was:
- Very useful
- Adequate
- Fairly useful

5. The contents of the Podcast were:
- Pertinent to my learning needs
- Somewhat related to my learning needs
- Unrelated to my learning needs

2. Study Guide Survey

With regards to the Study Guide, please respond to the following statements:

1. The Study Guide was**:**
- Too short
- Adequate in length
- Too long

2. Which purpose did you feel the Podcast served?:
- Learning how to apply knowledge to a professional context
- Prepare for a test
- Both of the above

- Don’t know

3. The Study Guide was:
- Easy to understand
- Fairly understandable
- Hard to understand

4. The Study Guide was:
- Very useful
- Adequate
- Fairly useful

5. The contents of the Study Guide were:
- Pertinent to my learning needs
- Somewhat related to my learning needs
- Unrelated to my learning needs

Appendix B: Survey for Stage 4

1. Please write the name of a course that you have recently completed and where you used Learning Materials delivered by the instructor for study purposes (these can be study guides, exercises, tests from previous years, PowerPoint presentations, PDFs, etc. Please don’t consider websites or web-based platforms)

2. In which semester did you take the course:
- First semester
- Second semester

1. The Learning Materials were**:**
- Too short
- Adequate in length
- Too long

2. Which purpose did you feel the Podcast served?:
- Learning how to apply knowledge to a professional context
- Preparing for a test
- Both of the above
- Don’t know

3. The Learning Materials were:
- Easy to understand
- Fairly understandable

- Hard to understand

4. The Learning Materials were:
- Very useful
- Adequate
- Fairly useful

5. The contents of the Learning Materials were:
- Pertinent to my learning needs
- Somewhat related to my learning needs
- Unrelated to my learning needs

Appendix C: Email message

Email subject
Five questions to build quality
Email message
Dear [name of the school principal] We need to know your perception of the Quality Report for School principals-2015 through five short questions. Thanks to your responses, we will be able to improve the materials we deliver. PARTICIPATE

Reminder email

Email subject
Reminder
Email message
Dear [name of the school principal] We understand that you have not been able to answer the survey we sent you. It would be tremendously valuable to us if you could answer the following five questions in order to improve the service that the Agency provides to schools. PARTICIPATE

Appendix D: Survey questions

1. The extension of the product seems:
   - Brief
   - Average
   - Extensive

2. The contents seem:
   - Very useful
   - Somewhat useful
   - Not very useful

3. You consider that this product is useful to:
   - Inform: transmit occurrences in education
   - Guide: gives information for practical use
   - Introduce: explains new concepts and approaches

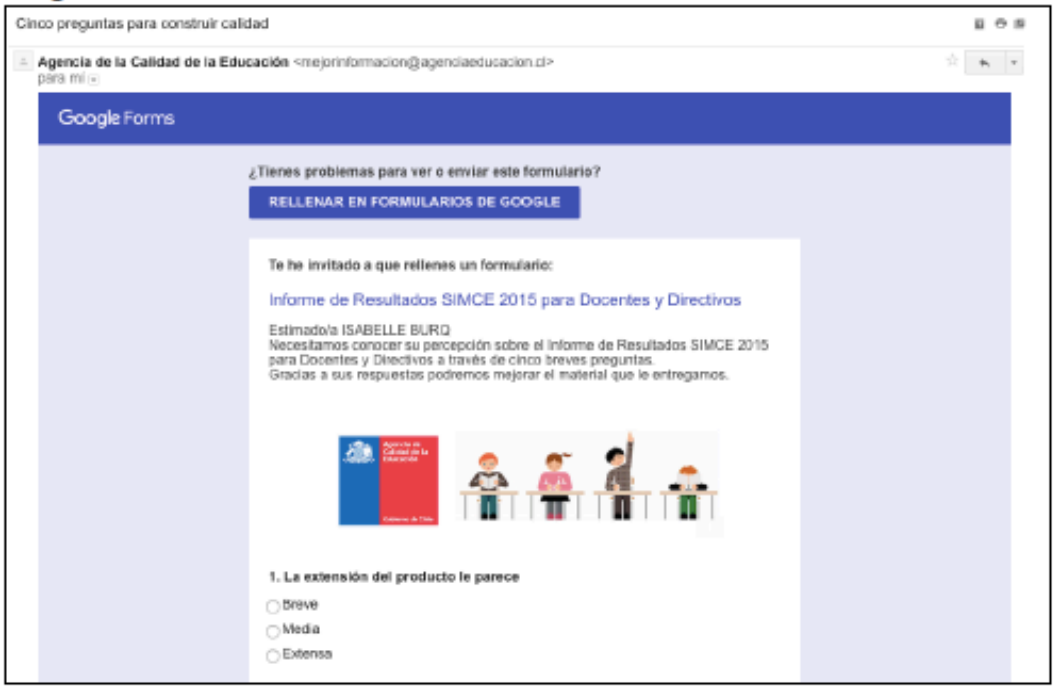
4. The understanding of the product is:
   - Simple
   - Somewhat complex
   - Very complex

5. Finding the information I need is:
   - Easy
   - Moderately easy
   - Hard

Appendix E: Web link and embedded email design

Web link email

Google Form email



Appendix F: Roles within the Quality of Education Agency's Information Division and the university research team

Stage	Agency roles	University Roles
Stage 1: UX needs assessment	1 Head of the Information Division 1 Member of the Information Division	1 Professor 1 PhD Student 2 Masters students
Stage 2: UX survey design	1 Member of the Information Division	1 PhD Student 2 Masters students 2 Undergraduate students
Stage 3: Survey 1	1 Head of the Information Division 1 Member of the Information Division 1 Member of the IT Division	1 PhD Student 2 Master's students 1 Programmer
Stage 3: Survey 2	1 Head of the Information Division 1 Member of the Information Division	1 PhD Student 2 Master's students 1 Programmer
Stage 4: UX needs assessment	1 Head of the Information Division 1 Member of the Information Division 7 Members of the Information Division	1 PhD Student 1 Master's student

Appendix G: Stakeholders of Public Service Information produced by the Quality of Education Agency

N|°	**User name**	**Description of tasks related to PSI**	**Examples of PSI developed for User**
1	School principals	The agency focuses its communication with the school system through a top-down process, in which the figure of the school principal is key for communicating information to each local school community. The principals' main tasks include: understanding quality reports, providing information to school boards, municipalities and parent associations, leading change in terms of teaching and learning.	-Standardized test reports - Workshop guide for making data-driven decisions -Manual: Using databases
2	Members of the Technical-Pedagogical Team	Putting educational goals into practice is a key process in every school. This is the role played by the members of the Technical-Pedagogical Team. In this sense, their main role includes supporting the school principal with tasks relating to: communicating test scores and short-term goals to the teachers, preparing teacher training materials & workshops and developing internal assessment processes, as well as other tasks involving the teaching-learning process within the school.	-Downloadable workshop guides -Infographics: how to understand test scores
3	Teachers	Teachers are key stakeholders of PSI, especially information that aims to improve classroom pedagogy. The Agency has therefore developed specific products which they can use to develop exercises and make changes to their teaching so as to improve the quality of education.	-Standardized test reports
4	Parents	Parents play an important role in the Quality in Education. The Agency has developed products that look to provide families with the information they need to choose a school, understand their role	-Brochure: what is quality in education?

		in the student learning process and how they can support their children and the school.	
5	School Administrators	Represent a local stakeholder by obtaining district funding for the school. Their main tasks involve providing schools with resources from the local district, understanding the school's administrative system, and bridging the gap between Government Information and local school needs.	- Standardized Test Reports with scores per district
6	Researchers	National researchers from the fields of Education, Economics, Sociology and Psychology, among others. Researchers frequently request access to the Quality of Education Agency's databases for research purposes. This most often involves analyzing how different factors can influence scores on national standardized tests.	-National test scores -PISA test scores
7	General Public	The Agency receives increased press coverage whenever the national test scores are published. This is because of the impact it has on school selection and public opinion with regards to public versus private schools.	-What is Quality? brochure
8	Policy makers	The Agency is part of a National System of Quality, which comprises three other institutions. One of them, the National Ministry of Education, drives public policy in education. Some of the information, mainly reports of national scores and statistics, is used to support decision making at government level.	-Data on standardized test scores -Research reports, test methodology

Appendix H: Focus Group participants

ID	Age	Professional background	Graduate studies	Experience in the agency (years)	Experience in information design (years)	Experience in User Studies (years)
1	39	Sociologist	Master in Public Managament	4,5	9	3
2	29	Elementary Math teacher	Certificate in Learning Assesment	1	1	2
3	38	Language teacher	-	5	10	7
4	43	Science Teacher	Master in Educational Computing	2	15	5
5	36	Teacher	-	2	2	2
6	37	Psychologist	-	4	4	-
	37			3,1	6,8	3,8