	A	B	C	D	E	F	G	H	I
1	**ID**	**API type**	**Phase**	**Specific activity**	**¿Artifact, tool, technique, guideline?**	**¿Affects usability?**	**Name**	**Description**	**Notes**
2	1	APIs in general	Design		Technique	Yes	Sketching	A sketch is a form of design that includes relatively less detail than a formal design. Sketches can be used to improve the user experience within an interaction design context by allowing designers to produce many experimental concepts that are iteratively refined in pursuit of the best final concept.	Sketching methods*:* *-drawings* *-writing* *-UML* *-Interface Description Editors*
3	2	Web APIs, supports "CRUD" and "Hypermedia"	Design		Experimental tool	Not mentioned explicitly	*Rapido: Sketching tool*	Experimental tool to facilitate web API sketching with both visual and literal methods. It's steps: 1. Create sketch project 2. Define vocabulary 3. Sketch the API 4. Model responde data 5. Export an API description	Viene ejemplo de diseño de CRUD y de una API de *hypermedia.* Herramienta experimental, no se encuentra disponible para probarla (o al menos no la pude encontrar).
4	3	Wrapper API	Requirements (initial and new, since it's a redesign), design, evaluation of usability		Design process	Yes	User centric design	Steps: 1. using input from stakeholder interviews 2. user requirements gathering sessions 3. pseudo-code study: prospective users would write pseudocode against an imaginary business rule API using a simple text editor 4. design and implementation of a prototype version 5. usability evaluation to assess its value: think-aloud study to evaluate the wrapper design.	Es por iteraciones Incluye caso de estudio Es rediseño, por lo que los pasos se realizan con el conocimiento de la API existente
5	4	Wrapper API	Requirements (Identifying user requirements according to author)		Technique	Yes	Interviews with stakeholders	Initial interviews with stakeholders and domain experts, is it designed to meet their needs (about granularity and flexibility)?. In terms of the cognitive dimensions [5], which provide a framework for describing usability issues and have been adapted to describe API usability [2].	
6	5	Wrapper API	Requirements (Identifying user requirements according to author)		Technique	Yes	User requirements gathering sessions	We ran six 60-80 minute individual requirements gathering sessions with existing BRFplus users. we asked the developers to first explain the overall purpose of their code that used business rules, and then to explain which parts of the BRFplus API they used, and how. We also discussed how they might have wanted to use BRFplus but were not able to.	Se realizó sobre una API existente, puede decirse que es la primera versión, para realizar un rediseño de esta
7	6	Wrapper API	Requirements (Identifying user requirements according to author)		Technique	Yes	Pseudo-code study	Before designing a wrapper API we first wanted to learn how users thought, what (if any) mental models they had and what terminology they used. We designed a study in which existing and prospective users would write pseudocode against an imaginary business rule API using a simple text editor.	
8	7	Wrapper API	Design		Artifact, technique	Yes	Prototype, prototyping	No description mentioned	Only mentions the design and implementation of a prototype version of the designed wrapper API.
9	8	Wrapper API	Usability evaluation on API design		Study, evaluation technique	Yes	Usability evaluation throught think-aloud study	[...] we designed a think-aloud study to evaluate the wrapper design. We based our API evaluation study design on the previous work on evaluating early API designs [1][8]. Participants wrote code that used the wrapper API to implement a series of tasks. We performed 60-90 minute sessions, this time to study the usability of the simplified wrapper API we proposed.	
10	9	Since it's a mapping study, it doesn't mention any specific type of API. The type of API depends of each methodology or study.	Usability evaluation		Methodologies and studies for usability evaluation	Yes	User Studies and Methodologies (4 in total: Cognitive Dimensions, Reviews, Mathematical Approaches, Concept Maps)	User Studies were the typical method. These studies often involve a small number of tasks being completed over a relatively short period of time. [...] Methodologies that researches proposed for evaluation a given API was also considered. Of these paers, the recommended methodologies borrow heavily from the field of human-computer interaction.	Dado que es una revisión sistemática, solo se mencionan y se listan las referencias, pero no se presentan descripciones a detalle.
11	10	APIs in general	Design Process		Design process	Yes	No name mentioned, but it was a design process in terms of usability	We propose an API design process. Firstly, "API analysts" analyze requirement documents to elicit minimal set of functions to provide. Secondly, "API designers" design APIs to fulfill functions using the guidelines that we proposed. Then, "Technical writers" document them. Finally, "API reviewers" evaluate the APIs whether they conform to the guidelines.	
12	11	APIs in general	Requiremets (Analysis according to author)	Elicitation, specification (although it doesn't mention it explicitly)	Technique, artifact	Yes	Elicit functions to be designed as APIs	The outcome: a) Requirement documents such as software requirement specification (SRS) documents b)or user experience scenario (UX Scenario).	Includes specification of requirements, although it doesn't mention it.
13	12	APIs in general	Design	Design following proposed design guidelines	Guidelines	Yes	Design guidelines based on usabilty criteria	Design: We propose design guidelines by referencing the criteria in the usability part of [4]. We select the criteria which are easy to apply and quantitatively measurable. There are three metrics: Unambiguousity, Convenience, Primitiveness.	

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14	13	APIs in general	Documentation		Artifact	Not mentioned explicitly	Documentation by "Technical writers"	"API designers" request to "Technical writers" to produce documentation when the designs are finished. "Technical writers" produce API documentation to make APIs convenient to use. The documentation includes necessary contents in terms of usage.	
15	14	APIs in general	Design and Documentation Evaluation		Evaluation technique	Yes	Evaluation conforming the proposed evaluation guidelines	"API reviewers" evaluate APIs and API documentation conforming to the proposed evaluation guidelines. The evaluation guidelines possess the design guidelines and documentation guidelines. The metrics are unambiguousity, convenience, primitiveness, and documentation.	
16	15	APIs in general	User-centered design process		Design process	Yes	Scientist-Centered Design (SCD)	The process is divided into four stages a) API design b)API implementation c) advanced execution semantics and, d) optimizations. At each stage in the process, we engage with the users to validate and refine the design and implementation as well as set project priorities.	The SCD approach does not use formal user models but key scientific users are identified and actively engaged through a formalized methodology at every stage of the software design and development life cycle.
17	16	APIs in eScience projects	Requirements (Design phase according to author)	Analysis	Technique, artifact	Not mentioned explicitly but it's part of a user-centered design process	Usage scenarios	Develop high-level usage scenarios that accomplish work goals.	To do this, the team must understand the work practices, work goals, what the scientists would like to achieve, and current similar tools. This can be accomplished by interviews and participant observation (i.e., watching them work). -or other elicitation techniques-
18	17	APIs in eScience projects	Design	Conceptual design	Technique, artifact	Not mentioned explicitly but it's part of a user-centered design process	Prototyping, "non-functional" low-fidelity prototype	Develop a low-cost prototype that is believed to address the work goals identified in step (1). API prototypes can take the form of a document describing the function definitions. Documentation and example code aid in early usability tests.	Designers may ask scientists to help brainstorm about design considerations and ideas in a form of participatory design.
19	18	APIs in eScience projects	Design	Design evaluation throught prototype	Technique	Yes	Usability study	The design prototype is used to engage users in a usability study for feedback. Methodology where users are asked to engage with the system through a well-defined set of tasks. Repeat the prototyping and testing cycle, increasing in the fidelity/functionality of the prototype at each iteration	Determine the testing medium that will be comfortable for the users to use. For example, Google docs was commonly used by all our test participants.
20	19	APIs in eScience projects	Design		Technique, artifact	Yes	Prototyping, functional prototype	The functional prototype is used to engage users to get additional feedback and the process continues.	
21	20	APIs in general	Design	API architecture design	Task, artifact	Not mentioned explicitly	Architecture creation and it's resources (description and code snippets)	Architecture design includes classes, functions, functions signtatures, names, contents of functions and classes.	
22	21	Software projects in general	Development process	Phases: design, implementation and test	Methodology	Not mentioned explicitly	eXtreme Programming	Metodología para las fases de diseño, implementación y pruebas	
23	22	Software projects in general, including APIs	Usability evaluation	Applied to output of each phase of the development process for each iteration.	Framework for usability evaluation	Yes	Cognitive Dimensions Framework	CDs has been successfully used in the past to evaluate usability issues in different software and APIs. The dimensions can be used as shared vocabulary to generalize results of the usability evaluation.	Fases más apropiadas para evaluar usabilidad: diseño e implementación.
24	23	APIs in general	Iteration 0; requirements and planning		Techniques, artifact	Yes	User stories	Creating or updating user stories as new requirements are obtained.	
25	24	APIs in eScience projects	Requirements (Design phase according to author)	Not mentioned	Technique	Not mentioned explicitly but it's part of a user-centered design process	Interviews and participant observation	The team must understand the work practices, work goals, what the scientists would like to achieve, and current similar tools. This can be accomplished by interviews and participant observation (i.e., watching them work).	[...] Participant observation (i.e., watching them work).
26	25	Not exclusive for APIs	Usability Evaluation (Design phase according to author)		Technique, guideline	Yes	Nielsen's usability severity ratings	The feedback from the initial User-Centered Design process is distilled into a list of usability issues and can be prioritized based on Jakob Nielsen's usability severity ratings [25].	
27	26	APIs in general	Development and evaluation process	7 phases: brainstorming, iteration 0, requirement and planning, design, development, testing, release.	Development process	Yes	XP + CD	Development process by combining a subset of XP practices with the CDs framework. n XP + CDs, all dimensions of the CDs framework are applied to the output of each phase of the development process to evaluate usability in the different phases for each iteration (design, implementation, testing, and evaluation). There is no check of usability during requirements phase, as there are no decisions regarding the design of an API architecture nor is any coding taken place during this phase.	Includes a case study.
28	27	APIs in general	Brainstorming		1	Not mentioned explicitly	Brainstorming	API stakeholders make decisions regarding the API ideas and the features.	

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29	28	APIs in general	Iteration 0		Task	Not mentioned explicitly	Release planning		
30	29	APIs in general	Requirements and planning		Task	Not mentioned explicitly	Preparation of setup and foundational work	Like the preparation of development enviroment and licensing development tool.	
31	30	APIs in general	Requirements and planning		Task	Not mentioned explicitly	Planning iterations	Selecting user stories for each iteration.	
32	31	APIs in general	Requirements and planning		Artifact	Not mentioned explicitly	Documentation and it's content decision		Not considered because of it's lack of information
33	32	APIs in general	Development		Several tasks	Not mentioned explicitly	Implementation, unit tests, preparation of documentation		Not considered because we are only considering the phases previous to the design phase.
34	33	APIs in general	Testing		Task	Yes	Creation of scenarios and it's evaluation	Creation of scenarios to perform acceptance testing and evalute the API from the API-user perspective. The scenarios are also evaluated against all the dimensions of the CDs.	Not considered because we are only considering the phases previous to the design phase.
35	34	APIs in general	Release		Task	Not mentioned explicitly	Make API available for use		Not considered because we are only considering the phases previous to the design phase.
36	35	APIs in general	Design		Guideline	Yes	Design guidelines	Design guidelines published on http://apistylebook.com/design/guidelines/ Some companies and government agencies share their API Design Guidelines with the community.	Online resource
37	36	APIs in general	Design		Guideline	Yes	Repository for API-usability information	Website https://sites.google.com/site/apiusability/Home	Online resource
38	37	APIs in general	Evaluation	Validation of usability	Guideline dor design evaluation	Yes	Nielsen's heuristic evaluation	Includes link for website https://www.nngroup.com/articles/ten-usability-heuristics/ And presents their mappings of the guidelines to API designs with a general example of how each can be applied.	Online resource
39	38	APIs in general	Evaluation		Study	Yes	User tests	Among HCI practitioners, running user studies to test a user interface with target users is considered the "gold standard." For example: think aloud usability evaluation with the API typically in a lab setting where users are encouraged to say aloud what they are thinking.	
40	39	APIs in general	Design		Guideline	Yes	Guidelines and heuristics for API usability	Comprehensive set of heuristics and guidelines for API usability that is a structured synthesis of the existing literature on API usability. Herustics acording to usability attributes: knowability, operability, efficiency, robustness, safety, and subjective satisfaction.	Guidelines presented in tables clasified by usability attributes. Includes case study. Roles identified for case study: • Usability engineers, Computer science engineers and PhDs specialized in usability and with previous experience in health informatics. • API developers, Computer science engineers in charge of maintaining the API • API users, will use the API in real systems
41	40	APIs in general	Evaluation		Guideline	Yes	Cognitive Dimensions Framework	In the context of API evaluation, the CDs framework is a powerful tool because it allows to compare users' expectations and designer's views of the APIs with what the system actually provides. For the sake of completeness, here we introduce a brief (and incomplete) description of the 13 main dimensions of the CDs framework.	
42	41	APIs in general	Evaluation		Guideline	Yes	Clarke's dimensions	Some authors propose an adaptation to the CDs framework based on transforming the dimensions into another base that is more meaningful for developers and that is compatible with shorter and simpler questionnaires. These new dimensions are called Clarke's dimensions and concentrate on 5 specific aspects of API usability: understandability, abstraction, expressiveness, reusability and learnability. All these high-level dimensions can be expressed in terms of the original CDs dimensions, but their operationalization for quantitative research is more practical due to a number of reasons. First, Clarke's dimensions illustrate the user's perspective (i.e. developer).	Includes case study. Our study is based on a questionnaire that evaluates developers' experiences in terms of Clarke's dimensions in a Likert scale. We created a questionnaire comprising 28 assertions which characterize the 5 target dimensions (understandability, abstraction, expressiveness, reusability, and learnability). For every assertion, users provide their degree of agreement or disagreement in a Likert scale from 1 (I fully disagree) to 5 (I fully agree).
43	42	APIs in general	Evaluation		Guideline	Yes	Methodology	Methodological approach for evaluating API usability combines several usability evaluation methods. It combines several methods in order to take full advantage of the strengths of each method. Following roles are present in our methodological approach: Expert, Developer, and Evaluator. The process consists of five phases: (1) planning, (2) heuristic evaluation, (3) workshop with developers, where the questions, problems, and potentials are evaluated, (4) interviews with developers and (5) the final analysis.	Case study is SOA-based API.