# How to design taskification in video games. A framework for purposeful game-based crowdsourcing

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When it comes to citizen science, games can play an important role encouraging voluntary engagement of the public in activities contributing to scientific investigation. This considering that, on the one hand, what appears as an interesting and challenging scientific topic may not be seen as captivating and engaging for the general public; on the other, that to address a scientific challenge it is often required a level of knowledge that acts a barrier to access. Consequently, it comes the necessity to develop projects with scientific tasks that can be accomplished by novices, while ensuring the interest of experts. In this context, game-based crowdsourcing approaches and taskification in particular can serve as powerful motivation systems. By integrating seamlessly the task into an established game experience, it is possible to target players and direct them to perform the crowdsourcing activity. Situated at the intersection of the three theoretical domains of gamification, serious games, and crowdsourcing game systems, this paper presents a framework to taskify games with crowdsourcing activities. Considering the role that coherently built story-worlds, narrative, and game mechanics play, the framework aims at providing designers with clear guidance for building purposeful crowdsourcing activities within video games.

CCS CONCEPTS • **General and reference~Cross-computing tools and techniques~Design** • **Human-centered computing~Collaborative and social computing** • Human-centered computing~Human computer interaction (HCI)~Interactive systems and tools

**Additional Keywords and Phrases:** Game Design, Taskification, Crowdsourcing, Framework

## 1 AT THE CROSSROAD OF GAMES AND CROWDSOURCING

Citizen science or crowd-sourced science identifies a typology of scientific research conducted by the public (crowd), who voluntarily engages in activities and by doing so contributes to scientific investigations [22]. Whereas well-established and has a long history, just recently the practice started to be supported by socio-computational systems to accompany and sustain participants' activities, leading steadily to more experimentations of public participation in scientific research. Citizen science initiatives stem from the much larger phenomenon of crowdsourcing, which in turn naturally arose from the peculiar "architecture of participation" of Web 2.0 [23]. The relevance of crowdsourcing lies in the outcomes of distributed large-scale communities of volunteers working together and producing coherent, validated, and reliable data [22]. Crowdsourcing is a model of problem-solving that starts by defining a problem to be solved and a goal to be achieved and scales the task environment by making it accessible to the public [3]. This creates a fertile environment where an inherently diversified audience per skills, backgrounds and expertise is empowered to

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participate and influence the resolution of a problem, offering creative and challenging perspectives. The practice taps into the notion of collective intelligence as a form of intelligence that is distributed, coordinated in real-time, constantly improving, and that results in an effective mobilisation of knowledge and expertise [18]. The concept relates to what Surowiecki [37] defines the “wisdom of the crowd”, a phenomenon that points out how under specific conditions groups of people manage to outperform even the best individuals or experts. Situated in and transversal to several domains, ranging from activities such as tagging or classifying images, to reporting sightings and counting (especially of animals), up to using problem-solving and reasoning skills to solve matters of societal relevance, successful citizen-science projects have increased. Involved in combinations of tasks that can only be performed by human beings, participants make a cooperative effort towards a common, scientific goal. However, a renowned issue increases the gap between theory and practice: what appears as an interesting and challenging scientific topic may not be seen as captivating and engaging for the general public. Additionally, the knowledge required to address a scientific challenge often results in a barrier to access. Consequently, there is a clear necessity to develop projects with scientific tasks that can be executed and accomplished by novices, while ensuring the retention of interest and engagement of experts and lay-experts.

Given this premise, games have largely been investigated as incentives to involve the public in crowdsourcing activities. Gamification became a progressively popular approach when designing crowdsourcing systems [10, 31, 34]. Counting on their ability to engage, provide constant motivation [7, 8, 16], and succeed in retaining users, while relying on the computational power provided by contemporary technology, games or gamified systems have been increasingly incorporated into citizen science projects to crowdsource data. However, literature shows that most studies addressing the topic of citizen science and public engagement take a quantifiable perspective, focusing on how data obtained or outputs measurement. Few studies attempt to look into the perspective of the participants and their engagement [12, 24], and fewer take the perspective of how to improve the design of such crowdsourcing systems.

Situated in this latter domain of investigation, moving beyond data collection, this research enquires game-based crowdsourcing systems. Here current matters regard the effectiveness of games such as *Foldit* [39] and *Eyewire* [32] to encourage the general public to partake in a project [29], questioning that games may play a role in attracting participation from gamers or the general public not initially interested in science-related contents, while reasoning on the importance of having intrinsic value able to retain players and raise concerns on the quality of the contributions – concerns particularly relevant in the context of citizen science projects where data contributes to scientific research [27].

Acknowledging limits and potentialities, as well as that the discourse on how gamification can influence motivation [19, 29], effective impact on engagement and participation of volunteers are still open questions [12], this research poses the attention on taskifying a game, from a design perspective. The reasoning to effectively design a crowdsourcing system in a gameful context, integrating seamlessly purposeful tasks, is especially considerate of the role played by story-world [40], narrative, and game mechanics.

### 1.1 Taskification: features and interplay with neighboring game-based strategies

This research focuses on taskification as a novel and unexplored methodology in game and crowdsourcing design. Theorized by few [26], academics still not widely endorse it even though its use is already recognizable in some real case studies. Taskification is the strategy of conceptualizing “the task as just one element or

mechanic to be part of a larger (possibly much larger) game world" [26]. When performing a taskification, the designer firstly defines the entertainment experience following commercial game design principles and later embeds an external purposeful task. This task can take different shapes and be either critical to progress inside the game or an optional activity, e.g. a subquest or minigame with which the player can engage freely. Prestopnik and Crowston [26] suggest different ways a taskification could occur in a commercial context:

(i) taskified games might be developed for profit and devolve revenues, along with crowdsourced results, to support scientific research;
(ii) tasks could be implemented as means to unlock game items, content, mechanics, or levels, mutating micro-payments systems in casual games and replacing the monetary exchange with a user performance.

The greater case studies of crowdsourcing game taskification – Project Discovery [5], Borderlands Science [9] – follow the latter approach.

Taskification can arguably be considered a subset of serious games (SGs, henceforth) development or gamification. The difference among these methodologies lies in the relation between the non-game task and the game itself: gamification covers the whole task with a gameful layer, SGs turn the task in the main mechanic of the whole game, while taskification embeds the task in a small portion of the whole product, usually hiding it in a huger environment with a great world-building. To strengthen the contrast with gamification, taskification can be defined as the use of non-entertainment tasks in game contexts, whereas SGs, defined as games designed for a primary purpose that is not entertainment [1, 38], can not include taskified games, since the latter are entertainment games augmented with a purposeful task. Moreover taskification, which does not involve the whole gameplay or experience but only a small part of it, can occur even after the game has been designed, diverging from SGs development and mirroring gamification process – starting from the task and then gamifying it.

Taskification is not recognized as a different process from game design or gamification and designers and researchers still do not share this concept. It is crucial to recognise taskification as a methodology per se and do not treat it as a common game design process. Turning an entertainment gameplay into a purposeful one is arguably a similar approach to gamification or SGs design. Moreover, as for many other innovative phenomena, the growth of this methodology matches with the rise of its peculiar ethical implications, which require investigations as soon as possible to avoid dark designs and applications. Game-based crowdsourcing systems struggle with many ethical issues because they lay in between different fields: they have to face the problem coming from the controversial use of crowdsourcing, games, gamification and persuasive technology in general. Hence, issues vary from unethical persuasion [2], exploitation [13, 36], manipulation [14, 30, 36], power imbalances [36], deception [41] and even physical and psychological damage [14, 30]. In particular, taskification may be ethical as long as it aims at social innovation, by helping research against cancer or other diseases for example [4]. However, employing taskification for commercial purposes and profit is highly risky of producing exploitative dynamics. All considered, it is a chance to unlock a novel methodology to foster social innovation: so far, taskification has been applied in this sense. Social innovation occurs when innovative ideas meet social goals [20] and improve society's capacity to create new social relationships or collaborations [21] and taskification case studies trace this pattern while providing access to new knowledge.

### 1.2 Towards a conscious and conscientious design of tasks

Taskification is a particularly useful methodology to build a crowdsourcing system that requires high numbers of participants, who can be found easily in mainstream games. By integrating seamlessly the task into the game experience, it is possible to target players and direct them to perform the crowdsourcing activity – an occurrence which requires further investigation [27]. Better yet, taskification might become the perfect method to intersect purposeful game design, the creation of meaningful play experiences, the economics of the game industry and the data requirements of scientists [27]. This is a very promising vision of the advantages of augmenting an entertainment game with purposeful gameplay through taskification. The experimentations in *Borderlands* [9] (borderlands.com/en-US/news/2020-04-07-borderlands-science) and *EVE Online* [17] (eveonline.com/discovery) show that such integrations can result meaningful for players and beneficial for both the game industry and scientists. Future research should "consider novel trends in games design and crowdsourcing" [19], and taskification could become one in the near future: only a few gaming companies (for instance CPP and Gearbox) have implemented scientific tasks in their mainstream games. Moreover, CPP is iterating on *Project Discovery* (eveonline.com/discovery), which demonstrates that they find it valuable for the company and want to keep it part of the game experience. Taskification emerged from the literature review [28] far less established than gamification and SGs design, but also highly promising to engage users in crowdsourcing activities as well.

Hence, this research focuses on taskification as an emergent method in the field of game-based crowdsourcing and, to encourage its growth, it investigates the process of design taskified games for crowdsourcing purposes. Indeed, the literature lacked insights on how to taskify and even on how practitioners reached their designs in real-world case studies. The theoretical understanding of the structure and components of a taskified game is little and designing one with so low direction might be quite hard. These systems are complex and intersect many different fields of expertise and they need a design process more conscious and conscientious to deliver desirable results. Hence, a research question arose quite naturally from these observations: how to guide a game taskification design process for crowdsourcing?

Frameworks are an underdeveloped segment of tools in the field of game-based crowdsourcing, where the attention is mainly drawn to gaining practice-based knowledge. Practitioners and researchers usually rely on experimental approaches that are ad-hoc for the matter of specific studies [4]. By presenting the core elements to design and their relationships in a clearly structured way, frameworks sum knowledge related to the specific field or bridge various fields to form interdisciplinary tools to sustain design processes.

## 2 RESEARCH AND DESIGN METHODOLOGY

In terms of research methodology, the framework relies on a wide transdisciplinary desk research (n: 131 resources and n: 30 case studies) situated in the game studies field, but reaches out to the domains of media studies and crowdsourcing studies. The review granted an extensive perspective on fundamental theories and practices, while identifying various approaches employed to combine games and crowdsourcing. In parallel, the desk research led to analyse the state of the art in terms of serious games, crowdsourcing games and systems, identifying and enquiring relevant case studies at the intersection of citizen science projects and games. Knowledge from different fields was collected, reviewed and synthesized to build a cross-disciplinary tool: a framework for designing taskified games. To validate its clarity, robustness, and efficacy, the framework was tested with the groups of game designers through a series of pilots (n: 3) in which participants (n: 9) taskified a

game. The pilots took place over the month of July 2020. Secondary data from the literature review was triangulated with qualitative primary data obtained from the three pilots as iterations. In each pilot primary data was collected conducting (i) moderate participant observations [35], balancing between “outsider” and “insider” roles, and (ii) semi-structured focus groups [6, 25], encouraging reflexivity about the experience. The analysis aimed at understanding the current limits, barriers, and possibilities of improvement of the framework, within an iterative design process. The data gathered from each experience informed the framework, leading to implementations later assessed in the following workshop as a testing ground.

## 3 RESULTS

The result of this research brought to sum all the knowledge acquired into a single tool which could lead taskification design. The specific literature on crowdsourcing and game design provides several frameworks which can be translated in the field of game-based crowdsourcing systems and support their design. Based on the wide literature review conducted on crowdsourcing and game design [28], a framework to taskify games was designed with the aim to provide designers with clear guidance for building purposeful crowdsourcing activities within video games. In the light of the reasoning above, it is situated at the intersection of three spheres: (i) Gamification, as the use of game design elements in a non-game context exploiting the games enjoyable features to make non-game activities more fun [7, 8]; (ii) Serious Games, as games designed for a primary purpose that is not entertainment [1, 38]; and (iii) Crowdsourcing game systems, which engage players in experiences that produce data to be used for scientific research [26, 27].

Building on this, the framework has a twofold scope:

(i) Providing a better understanding of the theories and practices of taskification as the process of integrating purposeful activities in entertainment gaming contexts; in doing so, it categorizes elements from game studies, media studies and crowdsourcing studies, analysing ongoing practices, and existing frameworks for exploiting underlay possibilities;

(ii) Providing a clear, integrated process for designing game taskification, entailing the different theoretical concepts that need to be considered in the process of designing tasks. The lay-theories and their interplay are hence combined into a two-step framework aimed at enhancing the players engagement in an entertaining crowdsourcing system.

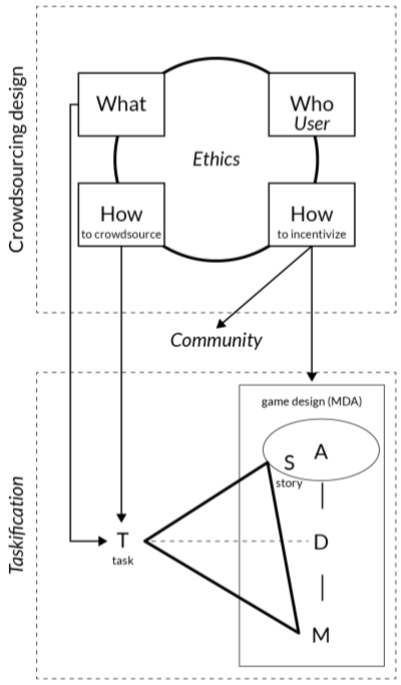


Figure 1: Taskification design framework for crowdsourcing activities.

The framework builds on two established frameworks, Simperl's [33] framework for crowdsourcing design and the MDA [11], a well-known tool for game design. Additionally, the framework relies on the SG-related concept of diegetic connectivity [15] to balance entertainment and tasks. Finally, a systematic review of guidelines from the literature on game-based crowdsourcing [28] highlighted other fundamental aspects of these systems that have been implemented in the framework design as well. The resulting framework (Figure 1) consists of two macro-areas, one on the top and the other on the button, representing respectively (i) the crowdsourcing design and (ii) the game taskification design.

The area of crowdsourcing design contains Simperl's [33] framework: "What", "Who", "How to crowdsource" and "How to incentivize". "What" refers to the matter that is crowdsourced, the high-level goal that the system attempts to address. It defines what contributions to expect and what to present to the crowd – which task and its design, which levels of expertise and tools. Along with the "What", the "How to crowdsource" supports the definition of the task, in particular its granularity, transparency and validation. The level of granularity refers if a task is either a macrotask (presents the activity as a whole) or a microtask (divides the task into smaller pieces). Transparency determines whether the task is explicit or implicit, the latter being the case of taskified games as participants' main activity is playing. Finally, validation refers to the system used to assess contributions, namely manual control or automatic tools, e.g. algorithms. "Who", endorsed by the "User" element derived from the guidelines review, aims at identifying the desired target to be participating in the crowdsourcing activity. It is crucial to identify what can affect participation, both positively (motivations) and negatively (barriers) and to use the correct platforms and communication to reach the desired audience. In the case of taskified games, it would be proper to design a purposeful activity for a game whose players are the ideal target for the task to be

crowdsourced and understand how to make them perceive the value of participating. Finally, “How to incentivize” leads to reflection on the motivation of participants and how to sustain them. In the case of taskified games for crowdsourcing purposes, the stimuli to engage with the crowdsourcing activity is the game itself and players participate because they consider the tasks intrinsically enjoyable or rewarding in the context of the game.

The “Ethics” element, another cluster of the guidelines, stands in the middle of the framework of crowdsourcing design. Ethical matters are a complex topic in game-based crowdsourcing and it is key that they are always considered through the process of design, as both the employment of crowdsourcing as well as the use of games to incentivize and persuade can be problematic. Considering the investigation on guidelines, the major issues on ethics concern the need for both a transparent relationship between the player and the crowdsourcer and of careful analysis of possible impacts on society and individuals. The following are some examples of ethical issues to tackle considering each aspect of Simperl’s framework [33]:

- What and how to crowdsource should not be unethical, e.g. harmful for someone – training an algorithm to steal private data for example;
- Participants should not be vulnerable categories, like children, who hardly could understand if they have been manipulated, and should decide to participate in the activity consensually, knowing the terms of use, which should be transparent;
- The system should not incentivize contributions by manipulating users and tricking them into exploitative cycles or using dark game design patterns [41].

The bottom area of the framework referring to game taskification design details the elements from the upper part and combines the MDA framework [11] and the diegetic connectivity [15]. “What” and “How to crowdsource” defines the task (T), while “How to incentivize” focus on how to engage users through the game, in particular, through its mechanics, dynamics and aesthetics – the elements of the MDA framework. Games produce fun experiences that attract people through their aesthetics elements: narrative, challenges, discovery, and so on. These experiences are supported by the game dynamics, namely its functioning system. This system in turn works thanks to the rule that composes it, i.e. the mechanics of the game. By combining and tuning these elements, games can engage players perfectly. Alongside, participation can be incentivized by community aspects of a game, a topic that emerged from the guidelines review, which does not necessarily have to be integrated into the game, e.g. wikis or forums. To connect the task with the MDA, the framework relies on diegetic connectivity, an approach that connects purposeful activity with games narrative and mechanics. Diegetic connectivity links the task (T), the story (S) and the mechanics (M). Hence, the task is linked to the MDA through mechanics and aesthetics, since the latter contains the story, intended as fantasy and narrative [11]. When designing a taskification, it is crucial to reflect on each of these relations and create new bonds between the MDA and the task without compromising the balance of mechanics, dynamics and aesthetics achieved by the game being taskified.

### 3.2 Testing the framework in field

The framework aims at providing knowledge and structure to design taskified games for crowdsourcing applications, hence its efficacy was tested in a series of three pilots. Three teams of three people each were asked to develop a concept of a video game taskification with a citizen science project using the designed

framework as a blueprint for guidance. A call for participants was launched among students and graduates from Politecnico di Milano and Università Statale di Milano. Nine participants between 25 and 30 y.o. (f: 3; m: 6) responded to the call and participated in the workshops. Participants were students (n: 2), employees (n: 3) or fresh graduates (n: 4). They all had previous experience in game design, either by attending game design classes during their studies (n: 7) or developing a MSc thesis on the topic (n: 2). Their backgrounds are designerly varied, with the intention of reproducing a small-scale simulation of a typical project team configuration: computer science (n: 2), automation engineering (n: 1), interaction design (n: 3), game design (n: 2) and communication design (n: 1). Three pilots were set over the month of July 2020, running for three times the iterative process of testing, observing, implementing. Some time was purposefully left between each pilot to leave room for the implementation informed by the data gathered from the previous testing. Participants were arranged into three teams (A, B, C) of three people each, applying the aforementioned distribution of skills, expertise and background, so as to obtain balanced teams. The team composition was the following:

- Team A: computer science, student (M); game design, graduate (F); interaction design, graduate (M);
- Team B: automation engineering, employee (F); game design, student (M); communication design, graduate (F);
- Team C: computer science, employee (M(; interaction design, employee (M); interaction design, graduate (M).

The data collected supported the initial hypothesis that a tool could guide the design of taskification. Six testers claimed the framework was useful, while two members of Team A and one of Team B expressed uncertainty. Out of the six participants who were positive about the framework, four stressed that its greater value was that it allowed them to employ low resources to taskify the game, namely a short time (eight hours) and a small team (only three members each); in every team there was at least a member who mentioned this point. Team C even claimed that the result of the taskification process exceeded their expectation and the framework supported their creative process, leading them to surprising outcomes. The doubts expressed upon the framework efficacy in leading the design process were about:

(i) the framework minimum game design expertise requirement;
(ii) the experimental setting of the workshop, which cannot recreate practical and business issues which could occur in attempting a taskification on a commercial off-the-shelf game;
(iii) the possibility to exceed designing aesthetic elements, neglecting mechanics and dynamics.

Indeed, the first comment demonstrates how a game designer is crucial in a team aiming to taskify a game and it is not a tool accessible to everybody. The second one unveils an area for further experimentation and analysis, namely the application of this framework on a real commercial case study. The latter actually might be misleading as the participant who pointed it out worked on a particularly narrative game, which may explain why this team paid so much attention to aesthetics. This circumstance occurred in the first pilot, and was not repeated in the following iterations, suggesting that improving the explanation of the workshop structure and tools already solved the issue. Data suggests that the framework can effectively provide knowledge to game designers to face taskification challenges. In particular, the framework proved to be effective in boosting the game design process for taskification and stimulating diverse solutions.

## 4 CONCLUSIONS

Starting from analyzing the field of game-based crowdsourcing, a promising and understudied concept emerged, identified as taskification. This research acknowledges it as a unique technique and distinguishes it from gamification and SGs by analyzing the relation between the game and the task in all three cases. In particular, taskification appears as a less intrusive approach than gamification and SGs design because it operates only on a small portion of an established experience. Hence, the first contribution of this research is the positioning taskification and the discussion on why it should be studied separately. Established frameworks in the fields of game and crowdsourcing design, and a wide number of guidelines derived from related fields support the tool herein presented, which was developed precisely to guide both the understanding and the conception of taskified games for crowdsourcing purposes by containing all the essential factors that constitute those systems. This theoretical framework sums the relevant aspects of both games and crowdsourcing to sustain the seamless design of additive crowdsourcing systems into the game structure. The tool relies on interdisciplinary knowledge and in particular combines two frameworks, the MDA [11] and Simperl's [33] framework for designing crowdsourcing, and exploits the diegetic connectivity approach [15] to connect them. The so-formed framework was augmented with the relevant topics derived from the guidelines review aforementioned.

Through its testing, the tool demonstrated great potential to reach its. Although it can be clearly improved, it is a first promising step toward the definition of tools and theories to understand, analyze and shape taskified games. The study on the ground of this research shows that there are still few examples of taskified games and little comprehension of the phenomenon, but as it grows, so should its analysis and study as inserting seamlessly crowdsourcing systems within video games to direct players power is undoubtedly thrilling for its many possible applications.

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