Gamified Co-design with Cooperative Learning

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Abstract
Co-design is an ideal approach to design with mixed teams that include learners and teachers. However, in modern learning contexts, learning and engagement are both key goals, and that poses several challenges to co-design. This paper investigates such challenges after outlining co-design and situating it in current user experience design trends. Then the paper uses the challenges to derive requirements for co-design, and shows how to meet requirements, fostering engagement as well as learning, by blending co-design with gamification and cooperative learning. It ends by showcasing a study that uses the blended co-design approach, and by outlining how this led to novel challenges and work.

Author Keywords
Co-design; Participatory Design; Co-creation; Cooperative Learning; Gamification of Learning; Learning Context; Children; Teachers

ACM Classification Keywords
H. Information Systems [H.1 Models and Principles]: H.1.0 General

Introduction
In recent years, *user experience* (UX) design has moved towards lean approaches. In lean UX design, design

activities do not release mainly documents: they iteratively release various minimum-viable products, such as low-fidelity prototypes [13]. Small-team work is fundamental for the creation of products: diverse experts sit together with designers and collaboratively create products so that the role of a designer "begins to evolve toward design facilitation [...] [so as to work] on the best solutions in an ongoing way". When the target product is educational and for children, the latter and possibly their teachers should become part of the design team with expert designers, as soon as possible, so as to bring their creativity in the design process [14]. In this setting, *co-design* with children becomes an ideal companion to lean UX design [8]: using specific co-design methods for children, these and possibly their teachers can be effectively promoted to design partners, and their ideas can be turned into products that get included in the lean design process. When co-designing in learning contexts, such as schools, learning becomes a key goal. More in general, engagement of children in any UX activity, at school or elsewhere, is fundamental for its success. For instance, in [18], playful engagement is claimed to be a key usability goal for any modern UX design activity, to be added to traditional goals such as "effectiveness, efficiency, and satisfaction".

Supported by such trends in the UX design literature and by our own experience in the TERENCE FP7 European project, dedicated to a traditional user-centred design of educational games for children [29], we decided to co-design games with a learning goal for learners, by engaging learners and their educators in learning contexts, and by making them play. However, several issues emerge when co-design is applied in modern learning contexts, with both learning and playful engagement as key goals. This paper starts with a short overview of co-design and the emerged issues. Then the paper shows how we blend co-design with gamification and cooperative learning for tackling such issues, so as to achieve learning and engagement in learning contexts. The blended approach is baptized *gamified co-design with cooperative learning* (GaCoCo). A GaCoCo study is outlined in the conclusions to show the approach in action and its viability.

Co-design

What Co-Design Is

Sanders and Stappers in [22] characterized co-design as an approach that extends participatory design and co-creation. Co-design allows us to create a shared language between users and designers so as to understand the new product from the point of view of all participants [2]. In this view, co-design attempts to actively involve all stakeholders in any design process activity. When children participate in a co-design activity, specific methods are used [9, 32, 14]. Examples are contextual inquiries, introduced in [7], for negotiating a new "power structure" between teachers and children with questions such as "what is an invention?", and low-fidelity prototyping with children [27].

Although members of a co-design team are involved in co-design activities on equal footing, they play diverse roles [27, 22]: users become co-designers as "experts of their experience"; researchers become facilitators to ease users' expression of creativity; professional designers bring in their professional experience of the product under design. The latter two roles are often merged in learning contexts.

When co-design happens in learning contexts, such as schools, children are equated with users whereas teachers can assume different roles. For instance, teachers can be

members of the co-design team as users that are expert of education and of the specific school context. Even if co-design has showcased different implementations in schools, also recently [30, 12], co-designers miss specific guidelines and face common issues when working in modern learning contexts.

Issues for Co-Design in Learning Contexts
Typically, co-design studies explore the satisfaction of children with co-design activities [14]. However, when placed in learning contexts, another dimension needs to be clearly explored: **which learning benefits** a co-design activity can foster, and **how they can be evaluated**. Often, the investigated skills are related to collaboration and discussion, which are left to the evaluation of teachers alone, e.g., see [11].

This paper also stresses that a co-design activity should be engaging, with fun, for nowadays children. In this respect, co-design in learning contexts meets the same challenges as any learning activity proposed by teachers, i.e., **how can one design engaging activities** for wide and diverse groups of learners, who are used to interactive digital tools and games, and often equate learning with boring rote? How can one **evaluate** that such activities are effectively engaging, in the short term or in the long term?

Moreover, **roles and requirements of teachers** vary across co-design studies, and are not always clearly specified. However, in studies in which they play a relevant part, teachers are in charge of: setting the learning goal, promoting discussion together with the design team as well as helping children whenever needed and, above all, evaluating the achievement of children. In this manner, teachers become full design partners and not only "teachers that teach" during the activity. In studies at the opposite extreme, teachers happen to 'just' assist co-designers in controlling the class behavior. That said, when drafting co-design activities for schools, one should also consider that teachers have short times for learning and may feel less comfortable than their learners with new digital products [11].

Another relevant issue is **how to organise learners in collaborative groups** with balanced skills. If such an organization is completely handed over to teachers and these are not sufficiently acquainted with learning theories promoting group work, the effects on co-design activities can be detrimental. For instance, consider what [31] reports in p. 29: "varying skills in writing and drawing created obstacles for collaboration in some groups in which the most dominant children overruled others, or resulted in lack of interest in some kids".

Another relevant issue is **how to organise learning environments**, e.g., the learning space and equipment. The organization of school space for co-design is often left to teachers and not considered with sufficient care by designers. For instance, the above paper reports that school tables resulted to be "too large" to enable close collaboration.

Blending Co-Design with Cooperative Learning and Gamification of Learning

Requirements for Co-design in Learning Contexts
A close inspection of the above issues results into the following list of requirements for co-design in learning contexts. Co-design in learning contexts should:

(r1) comply with and organize the learning environment, in particular, its space and equipment;

(r2) bring a learning value, and hence be related to class-appropriate learning objects/skills;

(r3) specify methods for organizing children in teams so as to enable fair team decisions and foster cooperative work, e.g., by avoiding dominance by some class members, and to enable the take-up of co-design in any type of school;

(r4) specify tasks and roles of teachers as part of a co-design team;

(r5) more generally, spouse a pedagogy theory that complies with the school/class one as well as with the co-design philosophy, quoting [8], so as to be "supportive of the 'partnership experience'";

(r6) be engaging for nowadays children and for diverse types of children;

(r7) be innovative, engaging and easy-to-take-up (i.e., not requiring a steep learning curve) for nowadays school teachers, which limits the time required for training them to be part of the co-design team.

More in general, and in particular if conceived as a short-term intervention, (r8) co-design should be concerned with a product or a design metaphor that is familiar to co-designers, so as not to require long training.

The last requirement is the simplest to satisfy. It requires a pedagogy expert or a strict collaboration between the design experts/researchers and school teachers for framing co-design activities together. Examples of products that satisfy the r8 requirement are so-called casual games [1], to which nowadays children are used and that the majority of teachers can quickly learn to master.

As for the other requirements, a pedagogy theory that well satisfies the r1–r4 requirements is *cooperative learning*. Such a theory, more than collaborative learning specifies easy-to-take-up frameworks and models for organizing cooperative learning teams [16]. However, in light of the r5 requirement, the adoption of cooperative learning should not be disruptive with respect to the school pedagogy theory, e.g., grading should be allowed if required at school.

Finally, the r6 and r7 requirements demand methods or frameworks that can help designers to frame co-design activities so as to promote and assess the engagement of all team members alike, including fun. *Gamification of learning* is getting popular for designing and evaluating engaging playful activities at school. Besides being a popular buzz word, gamification can be effectively engaging for learning if the gamified learning activities have clear goals and knowledge of participants. For instance, see [15], a meta-analysis of empirical studies of gamified activities.

In the remainder of this section, we try to corroborate our choices of cooperative learning and gamification for satisfying the r1–r7 requirements. More precisely, after outlining cooperative learning and gamification of learning more in details, we discuss what we can take from each of them and coherently blend into co-design.

Cooperative Learning

Outline. Cooperative learning is an instructional methodology that relies on constructivism. It comes with proven methods for organizing class work as group work, training social skills and more traditional school skills, so that children learn how to work together and mutually help each other towards a common goal [25, 26, 4]; it turns teachers into *reflective* teachers with the role of directors of the learning process, and assign them specific tasks [23]. Empirical evidence suggests that learners achieve significantly better school performances with

cooperative learning, e.g., higher achievement and greater retention [28, 16], and improved social skills. More in general, the use of cooperative learning at school seems to create a positive behavioral climate [21]. Outside schools, cooperative learning is used also in professional training; for example, from the software designer's viewpoint, cooperative learning helps learners develop the skills necessary to work in cooperation on projects that are too difficult and complex for a single person.

Main takings for co-design. Co-designers need to develop a sense of partnership. This is achieved in cooperative learning by enabling five elements: positive interdependence, promotive interaction, individual accountability, small-group skills, and group processing. The methods for organizing a team, e.g., the rules and roles for teachers and learners, are important means for enabling those elements and are the main takings from cooperative learning that allow us to satisfy all the r1–r5 requirements. For instance, in the *jigsaw* method [3], children are organized into a number of so-called jigsaw groups of 3 to 6 members. The class teacher first breaks a learning activity, with a common learning goal, into specific tasks, e.g., learning about the 5 planets closest to the Sun consists of 5 presentation tasks, one per planet. Then each child in a jigsaw group becomes individually responsible for a planet presentation. When all presentations are ready, children responsible for the same planet meet and share their knowledge in a so-called expert group, rehearsing their presentation. Finally, the members of the jigsaw group get together and each member teaches the others about their own specialty. Each of these groups then tackles the 5 tasks, putting all the pieces together to form the full picture—hence the jigsaw name.

Gamification of Learning

Outline. According to [1], at a high level, a game can be seen as a transition system: it has a *goal*, an *initial state* and *terminal* states, intermediate states with *challenges* to overcome, and *actions* of players for moving from state to state according to the game *rules*. Other crucial elements, drafted during the creation of the high-level game-concept, are as follows [17]: *competition* or *cooperation* elements; *reward* structures with juicy *feedback*, where the term juicy indicates effective, exciting, and engaging feedback; game *missions* whereby players progress from one mission to the next one(s) as they move toward the termination of the game; *storytelling*, providing context to the game. All such elements can be specified by means of a game framework for the design or the evaluation of games, such as those developed in projects like [10, 5].

In its most common acceptation, gamification means properly using game-based elements for a non-game activity and in a non-game context in order to engage people in such an activity [33, 6, 17]. In [18], that means that users become players of four main types or a mix of them: hard-fun ones who go for challenges and strategy-based play, easy-fun ones who love intrigue and curiosity, altered-state ones who play for escaping from their world, people-factor ones who use games for social experiences [19]. Activity tasks become missions, and are crafted according to the involved types of players so as to balance extrinsic as well as intrinsic motivation elements, and other typical game-elements such as challenges.

Several psychology motivation theories support the use of gamification and games for enhancing engagement in learning activities, see [17]. Moreover, the meta-analysis of [15] shows that, depending on the context and types of

players, gamification provides positive experiences for engagement and enjoyment, at least in the short-term, and possible negative effects such as increased competition.

Main takings for co-design. According to the meta-analyses in [15, 17], all the aforementioned game elements cooperate in making a learning activity engaging, depending on the involved types of players. Thus the gamification of co-design for cooperative learning contexts should first consider which types of players learners are. Then it should organize the co-design activity in tasks that are presented as missions, with game-based elements adequate to its players. That, however, should be done fostering social inclusion and cooperation, so as to be in line with co-design. Typically, such a constraint will mean to keep competition inter-groups so as to enhance intra-group cooperation. Moreover in a heterogeneous learning context such as a school, missions may have to be designed for mixed groups of children with different learning styles or different player profiles. For example, in the study reported in [20] and outlined below, cooperation and competition were used to generate intra-group positive interdependence. Study tasks were presented as progressive missions with timings, calibrated on the skills of the groups that were heterogeneous in terms of learning and social skills.

A GaCoCo Study

Purpose, Goal and Objectives
The reported study was run in a middle school. Its purpose was to explore the viability of GaCoCo and refine it for further studies—see the conclusive section below. Its goal was to design, with GaCoCo, prototypes of educational games for analyzing narratives for children, in a traditional school not used to cooperative learning, with pencil and paper as well as tablet devices. The goal was broken down into assessable objectives: (o1) children performance in missions for creating game prototypes; (o2) cooperation; (o3) engagement of children and teachers alike; (o4) learning value of prototypes.

Participants and Roles
The study was conducted at Luigi Negrelli middle school in Merano, with a class of 19 11–14 year olds, out of which 5 are non native Italian speakers, 3 teachers, and 4 game designers.

Roles for participants were specified in details as follows.

- Expert designers were one per group of learners. Then the former took care of illustrating the organization of work, coaching and scaffolding proper development (e.g., to resolve possible doubts, assist learners in case of serious risks of failure), observing children performance, cooperation and engagement.
- Teachers took care of: composing groups, conducting narrative reading with their traditional methods in class, stimulating conversation across groups when needed, assessing whether game prototypes developed consistently with the narrative analysis goal.
- Children were the main game prototype designers. Their work was organized for either small groups, individuals or the entire class. In the first case, they were asked to comply with cooperative learning rules for team work so as to "cooperate as best as possible".

Study Design and Schedule
The study was organized as an empirical one in three activities for estimating the above three objectives: pre activity, main study activity, post activity.

Pre activity. In the pre-study activity, expert designers organized a meeting at school with the school dean and interested teachers. In this meeting, the study design was explained. A week before the main activity, a training session for teachers was organized, specifying the role of each co-design team member and focussing on the role of teachers. Then teachers were asked to complete a simple form for creating mixed groups of learners; the form was designed so as to allow teachers to create groups balanced in terms of learning and social styles, as prescribed in cooperative learning.

Main activity. The main activity aimed at producing low-fidelity prototypes of games, at school, for further analyzing and interpreting narratives; this was the main learning goal. It was driven by a GaCoCo design and evaluation framework, based on that of [29]. More precisely, the GaCoCo framework helped game designers to: (1) organize the protocol of the main activity; (2) lead children through the design of their game prototypes; (3) gather data in a structured and uniform manner. Hereby we sketch the GaCoCo protocol only.

The activity was split into 3 main missions with predefined timings due to school constraints. Missions were linearly organised and each had to be completed before moving to the subsequent one. The first mission was for individuals, the second for small groups of children, and the third one was for the entire class. The second mission saw each group realizing their game prototype, orally, on paper, and on tablets. More precisely, the group mission was divided into challenges that activated different learning skills so as to suit different types of players. For instance, first, each group had to discuss and negotiate a specific game goal in relation to the narrative analysis goal, and then the player actions according to the negotiated game goal. Verbal skills were those mainly elicited. When realizing the prototype on a shared tablet, visual-motor skills were those mainly elicited.

Before children were divided in groups, they were made clear that groups would be competing against each other in creating game prototypes: the group best collaborating according to the expert designers and teachers, and realizing the best game according to other learners would see their prototype implemented as a 'real' game for tablets, to play with. However they were also told that the work of each group would receive a reward: a simulated interaction with each game prototype was video-recorded, and was made available online to all school participants, to be shown to friends and families.

Post activity. In the post-study, a debriefing was run involving the entire class and available teacher. Moreover, children were subsequently asked to fill in a paper survey with their impressions and desiderata with respect to the GaCoCo experience.

Main Results and Discussion
Data were stored in an open source DBMS and analyses were run by means of the STATA software. Hereby we report the most relevant observations for this paper.

Performance: objective 1. The performance of small-groups in the study was measured by tracking the success in establishing game elements of the game framework as follows. As for success, all groups managed

to produce all the required elements of games, except feedback that had to be set by expert designers in 20% of cases. Other game elements were produced spontaneously, e.g., 60% of groups spontaneously layered the game into missions and created a storyline. It is interesting to notice that, according to the conducted analyses, the presence of a child classified in the pre-study as global-creative by teachers seems to increase the number of game elements spontaneously produced.

Cooperation: objective 2. With videos of the main activity and written notes, all expert designers sat together and assessed the cooperation intra-groups with a 3-valued scale. One out of the following 3 values was assigned for each mission: low if the mission was carried on by only one group member, or by all but results were different and not agreed upon; medium if the mission was carried on by all members but there was one markedly dominant member; high if there was full cooperation intra-group, without dominant members. The majority of groups (70%) could cooperate with medium or high cooperation levels, and the presence of at least a child with a globally-creative learning style seems to correlate with high average scores of cooperation across missions.

Engagement: objective 3. Engagement was qualitatively assessed through teachers and expert designers' observations, and also through the analysis of the post-study survey, by inspecting three dimensions as in [24]: interest; enjoyment; concentration. The results were almost always positive. For instance, teachers asked expert designers to continue and make the activity part of their routine class lectures. The majority of children explicitly asked expert designers to return and design further games. However, such results should be handled with much care, e.g., the reported study was a short-term intervention and engagement in long-term activities may be different.

Learning value: objective 4. According to teachers, c.a 80% of games were coherent with the narrative analysis goal.

Conclusions and Further Work

This paper argues that co-design fits with modern approaches to UX design and is the ideal companion when the design team includes children. However, several challenges are laid before designers when co-design is situated in current learning contexts. After a short literature review, the paper exposes such challenges and hence derives requirements for co-design in learning contexts. It then argues how gamification and cooperative learning can be blended in co-design and can help the latter in meeting such requirements. The blended co-design approach is referred to as GaCoCo. The paper ends by reporting a GaCoCo study that served to explore the viability of the GaCoCo approach and to refine it. The reported study involved a middle-school class in the North of Italy. A further GaCoCo study was recently conducted with 4 classes of 2 primary schools in the North of Italy. In line with lean UX design, the low-fidelity prototypes of games produced in the North of Italy were evaluated by mixed teams, including game designers and teachers. In a subsequent GaCoCo design session, 2 primary school classes and designers in the Centre of Italy added game elements to the prototypes that were evaluated to be the 'best'. Such best prototypes were finally developed as tablet apps by game designers in the North of Italy and are being brought back to school.

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References

[1] Adams, E. *Fundamentals of Game Design, Third Edition*. Pearson - Allyn and Bacon, 2009.

[2] Ardito, C., Buono, P., Costabile, M. F., Lanzilotti, R., and Piccinno, A. End Users as Co-designers of their Own Tools and Products. *J. Vis. Lang. Comput. 23*, 2 (Apr. 2012), 78–90.

[3] Aronson, E., Blaney, N., Stephin, C., Sikes, J., and Snapp, M. *The Jigsaw Classroom*. Beverly Hills, CA: Sage Publishing Company., 1978.

[4] Artz, A., and Newman, C. Cooperative learning. *Mathematics Teacher 83* (1990), 448–449.

[5] Cofini, V., de la Pietra, F., Di Mascio, T., Gennari, R., and Vittorini, P. Design Smart Games with Context, Generate them with a Click, and Revise them with a GUI. *Special Issue of Advances in Distributed Computing and Artificial Intelligence* (Dec. 2012).

[6] Deterding, S., Sicart, M., Nacke, L., O'Hara, K., and Dixon, D. Gamification. Using Game-design Elements in Non-gaming Contexts. In *CHI '11 Extended Abstracts on Human Factors in Computing Systems*, CHI EA '11, ACM (New York, NY, USA, 2011), 2425–2428.

[7] Druin, A. Cooperative Inquiry: Developing New Technologies for Children with Children. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '99, ACM (New York, NY, USA, 1999), 592–599.

[8] Druin, A. The Role of Children in the Design of new Technology. *Behaviour and Information Technology 21* (2002), 1–25.

[9] Druin, A. Children as Co-designers of New Technologies: Valuing the Imagination to Transform What Is Possible. *New Directions in Youth Development: Theory, Practice, and Research: Youth as Media Creators 128*, 1 (Jan. 2010), 35–43.

[10] EMAPPS consortium. EMAPPS Game Framework. Retrieved January 2012 from http://emapps.info/eng/Games-Toolkit/Teachers-Toolkit/Games-Creation/Framework-for-Game-Design.

[11] Garzotto, F. Broadening Children's Involvement as Design Partners: from Technology to "Experience". In *Proceedings of the 7th Conference on Interaction Design and Children*, IDC '08, ACM (New York, NY, USA, 2008), 186–193.

[12] Giaccardi, E., Paredes, P., Díaz, P., and Alvarado, D. Embodied Narratives: a Performative Co-design Technique. In *Proceedings of the Designing Interactive Systems Conference*, DIS '12, ACM (New York, NY, USA, 2012), 1–10.

[13] Gothelf, J. *Lean UX*. O'Reilly Media, 2013.

[14] Guha, M. L., Druin, A., Chipman, G., Fails, J. A., Simms, S., and Farber, A. Working with Young Children as Technology Design Partners. *Communications of the ACM 48*, 1 (Jan. 2005), 39–42.

[15] Hamari, J., Koivisto, J., and Sarsa, H. Does Gamification Work?—A Literature Review of Empirical Studies on Gamification Does Gamification Work? *In Proc. of the 47h Hawaii International Conference on System Sciences* (2014).

[16] Johnson, D., and Johnson, R. An Overview of Cooperative Learning. *Creativity and Collaborative Learning* (2002).

[17] Kapp, K. M. *The Gamification of Learning and Instruction*. San Francisco: Pfeiffer, 2012.

[18] Kumar, J. M., and Herger, M. *Gamification at Work: Designing Engaging Business Software*. The Interaction Design Foundation. ISBN: 978-87-92964-06-9, 2013.

[19] Lazzaro, N. Why We Play Games: Four Keys to More Emotion Without Story. Player Experience Research and Design for Mass Market Interactive Entertainment, 2004.

[20] Melonio, A. Game-based Co-design of Games for Learning with Children and Teachers: Research Goals and a Study. In *CEUR Proc. of the Doctoral Consortium of CHItaly 2013* (2013).

[21] Panitz, T. *Benefits of Cooperative Learning in Relation to Student Motivation*. Michael Theall (Ed.), 1999.

[22] Sanders, E. B., and Stappers, P. J. Co-creation and the New Landscapes of Design. *CoDesign: International Journal of CoCreation in Design and the Arts 4*, 1 (2008), 5–18.

[23] Schön, D. *The Reflective Turn: Case Studies in and on Educational Practice*. New York: Teachers College Press, 1993.

[24] Shernoff, D. J., Csikszentmihalyi, M., Shneider, B., and Shernoff, E. S. A Student Engagement in High School Classrooms from the Perspective of Flow Theory. *School Psychology Quarterly 18*, 2 (2003), 158–176.

[25] Slavin, R. Cooperative learning. *Cooperative learning: Theory, research, and practice. Englewood Cliffs, NJ: Prenrice Hall.* (1990).

[26] Slavin, R. Student Team Learning: a Practical Guide to Cooperative Learning. *DC:National Education Association of the United States* (1991).

[27] Sleeswijk Visser, F., van der Lugt, R., and Stappers, P. Participatory Design Needs Participatory Communication. In *Proceedings of the 9th European Conference on Creativity and Innovation* (2005), 173–195.

[28] Stevens, R., and Slavin, R. The Cooperative Elementary School: Effects on Students'Achievement, Attitudes and Social Relations. *American Educational Research Journal 32* (1995), 321–351.

[29] TERENCE consortium. http://www.terenceproject.eu.

[30] Vaajakallio, K., Lee, J., and Mattelmäki, T. "It Has to Be a Group Work!": Co-design With Children. In *Proceedings of the 8th Conference on Interaction Design and Children*, IDC '09, ACM (New York, NY, USA, 2009), 246–249.

[31] Vaajakallio, K., Mattelmäki, T., and Lee, J. Co-design Lessons with Children. *Interactions 17*, 4 (July 2010), 26–29.

[32] Walsh, G., Druin, A., Guha, M., Foss, E., Golub, E., Hatley, L., Bonsignore, E., and Franckel, S. Layered Elaboration: a New Technique for Co-design with Children. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '10, ACM (New York, NY, USA, 2010), 1237–1240.

[33] Zichermann, G. Fun is the Future: Mastering Gamification, 2010.