# Challenges and Resolutions for Engaging Teachers and Students in Participatory Design of Online Science Learning Resources

Matthias Heintz, Effie Lai-Chong Law

Department of Informatics, University of Leicester, Leicester, United Kingdom
{mmh21,lcl9}@leicester.ac.uk

**Abstract.** Participatory Design (PD) is a key HCI approach relying on the involvement of end-users to provide insights into the development of a product/system. However, it is proved challenging to engage participants in PD activities, as shown by our practical experiences in a research project that is aimed to support teaching and learning of science with online labs and associated resources. Challenges include identifying convincing arguments about benefits of participation and demonstrating impacts their participation can have. We propose the use of an online tool such as PDot to support the traceability of PD feedback and the possibility of audio input. We will also explore the gamification of participation.

**Keywords:** Participatory design; Online labs; Teachers; Students;

## 1    Introduction

"*We have everything ready, but we don't have participants!*" Such a predicament is faced by a number of researchers planning to collect empirical data with human participants. While "everything" can include methodological approaches, ethical approval, research protocols, experimental instruments and other logistics arrangements, "participants" can be people from all walks of life, depending on the main goal and research questions of the project concerned. For a research project targeting school students aged 10-18 years old and their teachers with the respective population sizes being about 4 million and 0.5 million in England[1], one would expect that the predicament of participant recruitment might be less likely to occur. Nevertheless, our practical experiences of conducting Participatory Design (PD) studies with these target groups contradict such an expectation. In fact, it has been rather challenging for us to get teachers committed to participating in PD activities. The level of involvement of teachers, who are gatekeepers of access to students, has had a significant impact on student participation.

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[1]   https://www.gov.uk/government/publications/number-of-schools-teachers-and-students-in-england

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In this position paper, we describe the challenges we have faced and resolutions we have attempted to improve the quantity as well as quality of participation in our PD activities. We also discuss the implication for ameliorating approaches to engage people in PD.

## 2 Background

The context of Participatory Design (PD) activities that we have conducted is a European research project called Go-Lab (Global Online Science Labs for Inquiry Learning at School)[2]. Its overarching goal is to support science teaching and learning by providing pedagogically as well as technologically sound online laboratories (or online labs) and scaffolds (or apps), which allow their users to perform interactive experiments over the Internet [1]. Science teachers and school children from upper primary school up to pre-university colleges are the main beneficiaries of the project's outputs. To facilitate the attainment of the project's goal, a web-based portal called Golabz[2] has been developed to enable teachers to identify and utilize online labs, apps, online lessons and other resources for addressing learning needs of their students, who can also access and explore such resources on their own.

As for all computing technologies, it is crucial to ensure high usability, usefulness and attractiveness of the online labs, apps and other related resources to elicit positive experiences in teachers and students, thereby sustaining their motivation and interest in deploying them. Quality assurance can be achieved through the use of appropriate human-computer interaction (HCI) methodological approaches, including Participatory Design (PD) in the early phases of the project and User Experience (UX) evaluation in the later phases. This entails close collaborations between the HCI, software development, and pedagogy researchers engaged in the project (Fig. 1).

As depicted in Figure 1, the critical source of input is feedback from end-users/participants (i.e. teachers and students), who in the context of Go-Lab serve as informants, according to the IBF (Informed, Balanced, Facilitated Design) Participatory Continuum Model [2,3]. For "Informant Design", designers create a prototype and participants are then asked to provide insights into its quality improvement.

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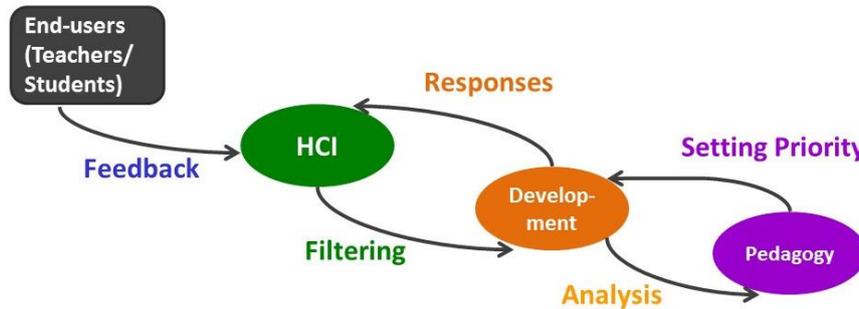[2]   Go-Lab: http://www.go-lab-project.eu/; Golabz: http://www.golabz.eu/

**Fig. 1.** Interdependencies of the project's teams.

## 3 Challenges

In the course of Go-Lab, based on our ongoing reflections on the perceived attitudes and observed behaviours of the participants in our PD activities, we have adapted different strategies and approaches to improve the number of participants and the nature of their participation. In the subsequent descriptions, we summarize the challenges encountered into two major categories, namely organizational and personal.

### 3.1 Organizational Challenges: Recruitment and Implementation

For our workflow of PD, participant recruitment was launched when prototypes, research protocols, data capturing tools and other setups were near completion. Recruitment for and implementation of our PD studies, despite the meticulous planning in advance, have been tricky because of several constraints:

- *Alignment with the development team's release plan*: The release plan was constrained by the contracted delivery dates of the project's products. While this restricted timeframe could help schedule participant recruitment, the maturity and stability of the prototypes under development, due to various reasons, might not yet have reached the expected status for the planned PD activities when they had to be conducted. This might run into the risk of undermining the participants' perception of the project's final products and influence their ability to give adequate feedback, especially with participants who are not used to provide feedback on prototypes. To address these issues we emphatically reminded the participants during the PD workshops that the prototypes presented were still under development.
- *Recruitment strategies*: A variety of recruitment strategies was used to acquire participants, including sending invitation letters and flyers about the PD studies to school head-teachers and to researchers' personal networks (via email), and publicizing the studies in other project-related activities. The design of the promotional materials played a critical role in convincing potential participants. To be most effective the text should be free from jargon and the images should illustrate the goal and activities of PD well. Of particular importance is to argue for the

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benefits of participation. This is proved challenging because putting emphasis on the value of participants' input for improving the project's products is apparently not convincing enough for many teachers, given their indirect relationship with the project and the timescale at which they could expect to actually benefit from the results.

- *School timetabling in connection with teacher/student availability*: While a number of our teacher-oriented PD studies have been organized as teacher training events/workshops in schools as well as non-school settings, the student-oriented PD studies have taken place only in schools. The reasoning for the latter is built upon the assumption that field studies can provide more realistic insights into how the online labs and other resources would be used in situ, thereby increasing the ecological validity of the findings. However, the drawback is the reliance on school timetables and technical infrastructure, which often do not match well with the project timetable and can be difficult to deal with as technical issues cannot be ruled out as part of the workshop preparation, but need to be dealt with on the spot during the running workshop.

### 3.2 Personal Challenges: Needs and Attitudes

- *Stakeholders' diverse needs*: Different stakeholders involved have different concerns about the participation in the PD studies. For teachers, their concerns may be whether the participation enables them to meet their professional development need or to address certain educational issues. For students, their concerns may be whether the participation is enjoyable and allows them to gain new learning experience. For the HCI researchers the main concern might be, whether their participation in the form of guiding the PD activities influences the quantity and quality of data. For other project partners, their concern can be whether their participation in terms of providing the online resources to be evaluated helps affirm the value of their research endeavour and enhances the reputation of the project. Nonetheless, some of these concerns may be incompatible. For instance, the HCI researchers aim to collect teacher and student feedback on a broad range of the online lab and app prototypes as early as possible in order to get a comprehensive understanding of the products quality issues. But this may deter teachers from participating because of the amount of time required.

- *Communication*: In our PD activities, the teachers and students have typically been asked to provide their feedback by annotating printouts of the online labs and apps of interest or by inputting their comments (textual or graphical) into a dedicated online tool called PDot (Participatory Design Online Tool) [4]. During our workshops we could observe a wide spectrum of the participants' attitudes and behaviours. Some of them have been on the 'cold' end, necessitating more encouragement and "pushes" from a researcher to share their comments on the online labs, apps and online lessons whereas others, once they had become comfortable with the situation, have engaged enthusiastically in the tasks given. Interestingly, some of the teacher and student participants tend to communicate their feedback directly to the researchers present in the PD study opposed to the tools

provided to give feedback. One plausible explanation for this tendency is that these participants may want to ensure that their voices have been heard (this basically aligns with the philosophy of PD) and to seek direct recognition of their contributions. Another explanation is that some participants simply prefer the modality of audio input.

## 4 Implications for Resolutions

Based on the practical experiences gained from designing and conducting the PD studies in the Go-Lab project, we have come up with some possible resolutions to address the aforementioned challenges of engaging participants:

- *Convincing teacher participants with mutual benefits of participation*: As mentioned, a common but rather ineffective approach is to use the argument "your input is valuable". Instead of emphasizing on one-way contribution, a "give-and-take" strategy may work better. In the context of Go-Lab, the teacher participants are offered the possibility of creating their own online lessons to address specific needs of their students with the use of the online labs and apps available in the portal. Our "bargaining token" can be asking the teachers to provide improvement suggestions on the resources that they would need for the creation of their online lessons. In return, the HCI researchers provide the support for such a creation process. Apparently, this mutual benefit model only works if the teacher participants are keen to create online lessons. Furthermore, integrating such "give-and-take" PD studies as a part of teachers CPD (continuous professional development) programme can also be a useful strategy to make them more attractive for teachers to participate.
- *Re-engaging participants through presenting changes:* According to the notion of problem ownership [5] in the sense of group problem-solving, people are motivated to contribute to resolving a problem if they feel responsible for it and their effort in improving it can really make a difference. Hence, it is relevant to demonstrate to the participants of our PD studies that the feedback they have given on the previous version of the online learning resources do have real impacts on their redesign. The traceability of comments can be supported with the use of a software tool like PDot [4], which allows the participants to retrieve feedback associated with the digital artefact of interest (Fig. 2 showing PDot). In addition, PDot enables continuous interaction between participants and developers/researchers by supporting consecutive evaluations in the same environment. These features can facilitate the creation of a sense of problem ownership in the participants, who would then be more willing to continue participating in subsequent PD and other evaluation work.
- *Convincing student participants with a bigger picture of participation:* As mentioned earlier, students got involved in the PD studies through their teachers. While the students could be exempted from taking part in the studies, none of them have opted out. However, their opting-in did not necessarily imply that they were engaged in providing feedback. In fact, their motivational level varied and influenced the quality of the feedback. To enhance the students' motivation, one can highlight the role of the HCI researchers in creating and ensuring the quality of

computing technologies. The PD experience the students gained can give them practical information to consider a possible future career in Informatics.

- *Augmenting the modality of participation:* For traditional PD approaches, feedback capture is primarily paper-based where textual description and sketching are the main data types. In recent years, the use of software tools to support PD work has increased [6], but the input modalities remain largely the same. Nevertheless, given the observation that some of our PD participants prefer voicing (literally) their opinions, we propose augmenting the modality to support audio input. With the increasing sophistication of speech-to-text technologies, this possibility is viable. Besides altering the modalities one could also aim to make the use of existing modalities more "fun". A viable approach to possibly achieve this, which has been used successfully in other areas than PD, would be gamifying the PD activities [7]. Through the motivational power of game elements, participants could be encouraged to give more feedback and do so repeatedly, once they have initially been convinced to give it a try.
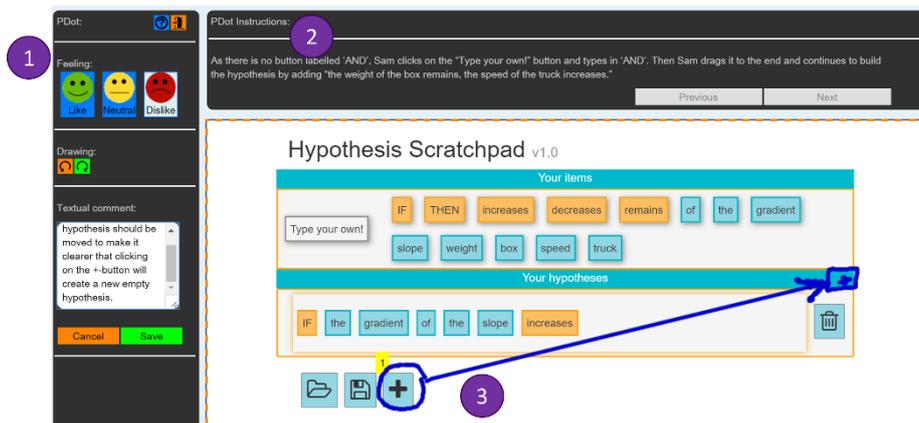


**Fig. 2.** Screenshot of PDot with three main areas: ❶ Functionality to specify feedback, ❷ Instructions for the participants and ❸ Prototype to evaluate with feedback.

## 5    Concluding Remarks

How can Participatory Design be conducted without participants? This sounds like a conundrum. Clearly, PD needs participants. The main challenge lies in how HCI researchers can engage participants in PD activities and make such activities enjoyable as well as meaningful to them. This challenge is especially acute when different target groups with different needs are involved. In the above descriptions, we have discussed some strategies such as the use of an online tool to enable feedback tracking. Other promising approaches to be explored to improve the experience of PD participation are audio input and gamification. This will be a research agenda of our future work to make participants want to take part in PD rather than have to.

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