Supplemental File 4: Appendix D

Summary of themes

Overarching theme	Sub-theme	Description	Examples
(i) Gamification for wider accessibility but not for super-users	Gamification for improving the accessibility of CS projects	CS projects often rely on a few dedicated members, and Gamification may be useful for easier presentation of information and improved accessibility to diverse audiences. It can get people interested in a topic that they don't generally care about, creating a bigger impact through the project.	*"I think anything you can do to get people excited about it…. doing it through a game, I think it's just awesome in general. So it gets people excited about it." (P14)* *"Well, I think it depends on the game that if the game entails… Envisioning future scenarios of you know… Or kind of this kind of forward-looking sort of perspective in which a game allows you to design future situation that if you do a then look at the world how beautiful it would be then, yes. So again it could simplify something that would be more difficult to envision." (P15*

	Apprehensions about gamification for super-users	Science is a serious activity, and most contributions to CS come from people who are motivated by science; hence, there is apprehension about adding Gamification elements for this contributor type. Gamification might make it seem like a non-serious activity.	*"Whenever there's an application that is very game like and like little..children play, then people take it less seriously in terms of science." (P16)* *"we did find it like that, that people are willing to go through that data because again, it's they're not necessarily there to have fun. They're not necessarily there to play like Angry Birds or whatever. They're there to. They're there to, to do scientific research." (P9)*
(ii) Changing Behaviour by enhancing capability and highlighting opportunity	Empowerment and education as a form of reciprocity for participation	CS volunteers often contribute to a project without financial compensation, and it is important they receive something back for their participation. Behaviour change through education and	*"In our farming with science projects, there is a goal to change the practices of the farmers, that they will change their practices in a more environmentally friendly way. (P4)."* *"…And I think citizen science can actually be a lens for facilitating social change, not only through like knowledge*

	empowerment may be one of those things.	*empowerment but also through social mobility…" (P11)*
Gamification for enhancing capability and highlighting opportunity	Gamification has the potential to support CS outcomes. Gamification elements (such as levelling up) can be used to indicate how volunteers have enhanced their capability in the domain they are participating in.	*"what if someone doesn't realise how much they've grown and how much they've learned? Because they're just like in their own head and their like mental model, they're just like, oh, I'm just a volunteer… I'm not a research scientist. And so they're just clicking away and they don't actually realise, like, you're now an expert…." (P9).* *"Like if you cover certain steps and you play the game all the time… it kind of infiltrates like in the back of your mind. OK, so this character that I'm playing, for example in the game and it's behaviour change along the levels of the game... Why is it like that? Or maybe I can do it like that?.... Research about it. Why is behaviour change, you know important. So I want to Google it or something. I think it has a ripple effect for sure, yeah." (P2)*

(iii) Barriers to gamified behaviour change	Barriers to changing behaviour through CS	Behaviour change cannot always be the goal of CS. Such a project would also require the right kind of expertise on board.	*"…Whether it should be the aim of citizen science projects, I think if it became the primary aim of citizen science projects, you might start to question whether citizen science was the most effective way to lead to that behaviour change." (P12)*
	Barriers to achieving a successful gamification design	There is a lack of proper guidelines and resources to design a gamified CS project. Gamification success is also extremely context-dependent.	*"I've mixed feelings, so I think, I've, we've discussed it and each project has had its own sort of, peculiarity, that make gamification more or less suitable…" (P15)*