Co-design of Technology Enhanced Learning (TEL) Resources:
Drawing on and drawing out everyone's experience, expertise and creativity

Introduction

This paper is written from our perspective as two educationalists who, for 10 years, have been heavily involved in both developing and evaluating technological resources (eBooks, apps, online resources etc.) within healthcare education settings. It offers advice on how to increase the likelihood that learners/trainees will both adopt and benefit from new technology enhanced learning (TEL) resources. Based upon our experiences of implementing co-design, the paper outlines a truly collaborative development approach that values learners' expertise and creativity throughout design and implementation. This paper will be of interest to clinical teachers who are leading or contributing to the development of a TEL resource. It assumes that the decision to undertake a TEL development has already been made, based on an assessment of needs, opportunities and resource availability (1) and focuses on providing advice for how to adopt a co-design approach within the development.

Over the years our own practice has developed from faculty-led resource development to a more participative co-design approach involving learners at all stages of the project. The MBChB (Bachelor of Medicine and Surgery programme) Mobile project (2) was one of the first compulsory programmes in a medical school in the United Kingdom (UK) to support large parts of the curriculum, both on campus and in clinic, with technological resources (for example by providing mobile learning resources and developing apps to capture placement reflections and assessment). Evaluation of this programme established that this approach to curriculum delivery allows students to access key learning resources at a time and place that best suits them and their learning (3). As the programme developed, it became apparent that student involvement in resource creation was key; initial trials of faculty-only designed resources resulted in some resources being ignored by large numbers of students, and we had to develop new ways of working with students rather than trying to develop resources for them. Our subsequent TEL developments have more actively involved the students in both designing the resources and evaluating their use. The Learning Layers research project (4) provided us with the opportunity to explore whether a co-design approach was also practical when working with busy healthcare professionals and developing tools to support their workplace learning. Specifically the project worked with teams and networks of healthcare professionals based in general practices (family doctors) within the UK. Together we identified pain points in their current working & learning

practices and then co-designed and piloted tools to support them (5,6,7).

In the following section we briefly outline why co-design is being increasingly recommended and adopted within technology development projects; we then set out our advice (based on our experience) for others who want to use co-design.

Why adopt a co-design approach in health professional education?

Technology increasingly plays a major role in supporting and enhancing learning processes, both within formal education and continuing professional development. Going beyond user-centred design, co-design actively involves users in the design process itself in order to help address some of the issues that have led to high rates of failure in Information Technology (IT) and TEL projects, such as inadequate understanding of user requirements, low user involvement and low commitment by users (8). In co-design the tools are not being designed just for users, but <u>with</u> users who bring a deep understanding of their context, their needs and the opportunities that can then be explored with the developers. In our experience, this is fundamentally important for the development of tools for use in health professional education, where both supervisors and learners alike have limited time to trial new resources, and need the tools to be 'right', as otherwise they are quickly dismissed. Such an inclusive approach aims to ensure that when new technology is introduced it meets learner needs, fitting into and enhancing existing working and learning practices (9,10). It has been claimed that co-design methodology (albeit not necessarily explicitly named as such) can result in innovations being adopted more quickly and effectively in healthcare (11), although these benefits have to be balanced against the likely extra costs involved (12). Additionally choices have to be made about how participatory the process will be (13), for example how much input users will have into the creation of design ideas and choices and the making of design decisions.

In the next sections we provide our advice on the important aspects involved within adopting co-design process: building a co-design team, adopting an agile development approach, facilitating creativity and learning from the design iterations and testing of the tools in the real-world. For clinical teachers, this co-design approach could be useful for developing new work-based assessment resources, revision tools for OSCEs or other clinical examinations, or even for developing new ways of providing learners with qualitative written feedback.

Building a co-design team

The first step is to build a co-design team including users, designers, developers and (if appropriate) researchers, who will work together to design and test the TEL tools and resources. The users in the co-design team would ideally include representatives from all those for whom the resource is ultimately intended (this could include students, trainees, clinical teachers, administrators, healthcare professionals), at all seniority levels, since they are likely to have different needs, expectations and experiences relevant to the development. It is important to include not just those who consider themselves 'tech enthusiasts' or 'tech savvy' but also those who are more wary of new technology – their views on functionality and purpose of the technology will be key to its wider success. There are many benefits to being part of a co-design team. These can include new learning opportunities, exposure to new ideas / people / technology, an enhanced profile through engagement in new networks, conferences and spin-out projects. We recommend emphasising these potential benefits when recruiting co-design team members.

Adopting an agile development approach

It is important to ensure the co-design team understands and agrees on the process they will be following. Co-design should ideally form part of an iterative, agile development approach. Such an approach does not presume that the best solution/resource is designed during the first phase of development. Instead it recognises that better solutions can emerge and evolve following reflection on each design/development cycle. This aligns with the Design Based Research approach (14,15) and the iterative evaluation approach espoused by Pickering & Joynes (1). The model we recommend is illustrated in Figure 1: showing how each design iteration involves four processes and how the understanding reached at the end of one iteration then starts the design (or re-design) process for the next iteration.

Figure 1: Agile development and co-design process
(Key processes in central orange loop with <u>example </u>iterations around this)

Facilitating creativity

The co-design process draws on the creative potential of all team members. We therefore recommend using accessible design tools to allow the whole team to be designers. This means providing the team with design objects and tasks that allow all stakeholders to 'design' and 're-

design' the software. Table 1 sets out a range of tools and approaches that we have used in Learning Layers and MBChB Mobile to support the idea creation and creativity processes in co-design. These can be used at various stages of the co-design process.

Table 1: Approaches and tools to support creative design input by users

Figure 2 shows a storyboard describing a possible future working/learning process. Figure 3 shows one of the paper prototypes used in the Learning Layers project. In both cases the tool (storyboard or paper prototype) was produced by the developers on the team (based on input previously gathered from the whole co-design team). However, both the storyboard or paper prototype could then be easily changed or added to (simply using pens, scissors and post-it notes) by the whole co-design team. Therefore everyone was able to actively contribute to the design.

Figure 2: Storyboard created by one of the Learning Layers co-design teams

Figure 3: Paper prototype developed and used by one of the co-design teams

Learning from the design iterations and real-world use of the tools

Adopting the agile development approach we have proposed involves safely trialing the resources as early as possible and keeping careful records of how and why the design features of the resource are used by learners. Such trials can involve using paper prototypes in workshops and/or field-testing the tool/resource in real-world contexts. This then provides opportunities to learn at each stage before progressing further. Careful record keeping is essential. We recommend that at the start of each field-testing/evaluation stage, the co-design team records the design features that are currently included in the tools implementation and then notes how each of these are used within the trial: are they adopted as expected, adapted and used in an unexpected way, actively rejected or simply not used or unnoticed. In our experience, this record keeping supports the co-design team in discussing and reflecting on why the tools are being used in this way and thus helps the team to better understand the learning context and take decisions about how the tools/resource should be further developed. To obtain such a detailed understanding of how the

tools were being used involved, in our cases, a mixture of direct feedback from members of the co-design team, observations of tools use in workshop settings and/or focus groups run during and after a field-testing period.

Testing and refining

Whilst field-testing and using the tools in real practice is important, we strongly recommend that educators ensure the developers have run a reasonable level of tests on the tools themselves to check that they are ready and that adequate support is in place for users. Releasing error-prone versions of resources can result in disengagement from the co-design process by the users who initially agreed to help, particularly those who were already wary of technology. However, this must be balanced by remembering that releasing early versions of TEL resources is bound to uncover issues, which is the very purpose of piloting the resource with a small group. So managing expectations is also important. We recommend emphasising to learners/users their role as early adopters and pioneers, whose feedback will help fix issues and influence the further development. It is also important to be clear about the function of the newly released tool; users may complain that it does not do what they want, when this may never have been the intention for the technology. Such a discrepancy (between the intended use and the actual use) is also something that should be picked up by the record-keeping described above, and would be one of the issues to reflect on when deciding on the next stages of development.

Conclusions

In our experience, co-design has the potential to help develop innovative TEL resources that are more readily adopted by users. We aim to provide clinical teachers with an overview of different ways of implementing co-design so that they can choose the approach that best fits their own TEL development project. For example a light co-design approach (such as that used in the Mobile MBChB project) could involve just 2 design iteration loops, using observation and storyboarding, but skipping the paper prototyping to move straight to software prototypes. In such a light-touch approach the user input in decision making might be gathered within the co-design sessions as interviews or focus groups. At the other end of the spectrum a deep co-design approach may involve several design iterations at the storyboarding and paper prototyping phase before moving into software prototyping. For example in the Learning Layers project there were 9 design iterations in total and we moved back and forth between paper prototypes and software. Additionally, users in a deeper co-design approach could also provide input to decision making through commenting directly on the plans and taking part in the decision making meetings. As

these guidelines and examples make clear, co-design requires time and investment, and an openness to new ideas and compromise is key for all involved. However, when successful, co-design repays the effort invested by producing tools fit for purpose that deepen understanding of learning processes in our chosen contexts and how technology can best support them.

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Purpose / Stage	Design tool / approach
Analyse **Understand the current context** Identify and describe the current context into which the TEL resource is going be introduced - how do people currently learn	**Storytelling**: users explain to the research team how they currently work / learn, and identify areas where technology might help them solve challenges. This can be done with "context cards" where pictures act as prompts for users to explain working practices and/or users are invited to add to the set of context cards. **Storyboarding**: researchers and designers present their ideas for where technology could enhance working or learning practices based upon earlier interviews and focus groups with users
Design **Imagine a possible future** Describe a possible future in which the TEL resource supports learning in this context. Provide users with a way of describing/designing the functionality/features of the TEL resource before technical development is undertaken.	**Storyboarding** is also appropriate for use at this stage, since users can change and refine the storyboards created in the previous stage, in order to reflect what they would like to happen rather than what does currently happen. **Games**: designers develop paper-based games which allow users to 'try out' the idea of where technology might help them as they go through the game. Once played, users can change 'the rules' of the game to better suit their needs. These rules can then form the basis of a first tool or resource prototype. **Paper prototyping**: design for the TEL tool or resource is created in paper and presented to users who can then explore and adapt it. Users can easily make changes (using pens and paper), adding or deleting functionality or changing the interface.
Test **Trial or pilot the design** Check (prior to technical development) if the design can adequately support a real use case	**Testing the design in a paper prototype:** users bring a real use case (scenario) to 'play' in the paper prototype. This checks more thoroughly (on paper at least) whether the technology would meet the needs of the users and also identifies workflow issues.

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