PREFACE

Co-Creation in the Design, Development and Implementation of Technology-Enhanced Learning

1 Introduction

Co-creation is a term encompassing various forms of active stakeholder engagement and collaboration aiming at (i) innovation and research results that are more relevant and responsive to society, (ii) wider and more efficient adoption of research and innovation, and (iii) stronger ties of innovation with the individual end user/consumer. Several approaches have emerged to support these aims, including Co-Design, Co-Production, Participatory Design, Design-based Research, Research-based Design, Living Labs and DevOps, which we subsume under the term co-creation. All of them have a strong ethos of valuing and involving the experience, expertise and creativity of all members of a user community and wider society at least equally to those of the "formal" product/content creators [1]. Co-creation is also an important means to adhere to the EU's Responsible Research and Innovation agenda and part of the 'Science with and for the Society' objective [2].

Within the TEL domain, co-creation plays a particularly important role as design and development move from relatively well-understood school-based or formal learning contexts into less structured and less well-understood areas such as informal learning and continuing professional development. Additionally, with wider acceptance of user-generated and digital open educational resources (OER) into formal and informal education, co-creation emerges as an invaluable tool for timely, relevant and high-quality digital content availability in TEL solutions. TEL appears as a natural "habitat" for co-creative approaches. The necessary co-creation focus on multiple stakeholders ties well with the interdisciplinary approach that is needed both in developing and deploying TEL designs. The democratic methodology that fosters equal voices and community-guided design goes along with TEL's need for creative thinking, while maintaining a view of real limitations that are inherent in the underlying technologies and domain practices.

In this context, this special issue aims to present an evidence-based discourse on the conceptual and practical challenges that arise from incorporating collaborative, creative and stakeholder-oriented principles in TEL environments. Crucially, the use, effectiveness, and impact of these co-creation approaches in the TEL community need to be better understood, allowing for the implementation of traceable and trustworthy studies meeting the standards of the TEL community at the same time.

2 Questions Addressed by Papers in this Special Issue

The papers[1] that comprise this special issue provide insights and responses to several essential questions on this topic. Below we provide an overview of the issues and insights raised within this special issue, including signposting to some of the papers in which these are addressed in more detail. The questions addressed by the papers include:

[1] To help readers to distinguish between references to papers within this special issue and references to external references, we have put the references to special issue papers in bold.

- In what contexts and for what reasons are co-creation approaches being used in the TEL community?
- What are the characteristics of the co-creation approaches being used in TEL?
- What are the issues facing co-creation in TEL?
- What is the impact of using co-creation in TEL?
- How to scale up co-creation activities in TEL?

Together the papers show the wide variation in contexts in which co-creation approaches can be used by the TEL community. The papers include both school [3,4] and university-based [5,6] contexts in which the students are the co-creators, as well as professional learning environments in which the teachers, developers or tool users are the co-creators [7,8,9,10,11]. The contexts are not limited to formal education settings, but also include settings in which non-formal or informal learning [11,12] is the focus.

The rationale given for adopting a co-creation approach is often the belief that such an approach will lead to a more relevant and directly applicable TEL tool or platform with a higher fit to practical requirements [3,6,7,8,10,11,12], but many of these special issue papers also highlight the expected impact of the co-creation on participants themselves in terms of increasing their TEL literacy and, hence, self-confidence [8,9] leading to more positive views of TEL or STEM [4,9] and supporting knowledge exchange [7,12].

Several papers [7,9] clearly state how social knowledge creation theories (Knowledge Appropriation, Communities of Practice and Sensemaking & Meaning Making: [13,14,15]) underpin their approach. Of course, these two aspects (tool design and knowledge creation) are linked since it is at least partly the knowledge development in terms of the shared meaning as well as understanding that develop during co-creation activities that contribute to better tool design and is mirrored in it. But it is noticeable that some TEL co-creation approaches are more focused on the impact of the process on the participants, whereas others are more focused on the impact on the resulting tool design.

There are a range of methods used to structure the co-creation activities reported in these papers, but common themes are the use of face-to-face participatory workshops, structured design iterations including research question, re-design, method and results, for example, and collaborative/project work involving multiple stakeholders. A smaller number of papers report on co-creation work where technology itself is being used as the platform to connect the co-creators and structure their contributions [11,12].

Whether the multiple stakeholders involved in the co-creation have equal roles or decision-making powers in the co-creation varies across the work reported. As a term co-creation in TEL is currently being used to cover a range of approaches including those that seek users' ideas or feedback on designs (but with no decision-making role for the users) to those in which the participants can actively create the designs and have a more powerful role in the development decisions. This highlights that there is certainly scope for further work on defining co-creation in TEL, its core components and the different ways in which it can be implemented. One of the papers in this special issue [12] makes a useful contribution to this ongoing discussion by exploring the differences between co-creation and co-design.

A significant number of the papers explicitly state that they are using co-creation as part of a Design-based Research (DBR) approach to their TEL work [5,6,8,10]. Such studies use a collaborative and iterative knowledge creation and design approach to contribute not only to an improved TEL design but also to our understanding of

their specific context and to reflect on theory. Such work is very valuable in giving insights on multiple levels and through different stages of development. As such it tends to involve rich qualitative data. This is time-consuming and complex, which explains why many of the papers identify the scope of their study (in terms of numbers, context or time) as a limitation. These limitations serve as a reminder of the complexity involved in undertaking such DBR-focused co-creation and the resulting need for researchers to carefully choose which aspect they will be able to focus on and investigate.

It also highlights the need for further work on scaling co-creation approaches, work that is addressed by at least three of the papers in this special issue. These papers look at using technology to help scale co-creation engagement [11] and embedding co-creation within formal education activities [9,12]. A method of scaling that is used in this special issue is that of a multi-layer approach. In one paper [6] a learning environment for a university lecture is co-created by gradually narrowing the number of participants from many (through surveys) to few (through specific aspects for developers). Similarly, another paper [11] opens up the design space of TEL applications from a few participants actively proposing design iterations that are then evaluated by a crowd of users.

Two other key issues are highlighted by the research in this special issue both of which relate to trying to capture the 'big picture'. One is the suggestion that researchers would benefit from adopting a range of co-creation approaches/techniques rather than relying on one approach [3,6,7]. These researchers suggest that different co-creation activities can capture different parts of the picture. This approach would also allow for some simpler (but larger scale) co-creation to be combined with more intensive (smaller scale) co-creation. The final key issue raised is that of diversity. It addresses the difficulty of ensuring that diverse views actually have been captured [8,10,11]. Co-creation aims to capture diverse views by including multiple stakeholder groups in the creation activities. However, some co-creation set-ups may result in only those with motivation, experience and time taking part. Difficult decisions may also need to be made, in some cases, regarding the prioritization of input from different groups. Finding effective ways of managing representation and decision-making in such rich co-creation eco-systems is a question worth further exploration.

3 Guest Editors' Reflections

As Guest Editors, we were delighted by the breadth and depth of the work submitted to this special issue. It highlights the growing use and importance of co-creation approaches in TEL as well as contributing to our growing understanding of the issues related to successful and impactful adoption of these approaches. Reflecting on the whole body of work reported in this issue three key areas emerge for us:

- variations in how co-creation is interpreted & enacted;
- the complexity of co-creation & how to manage it;
- the challenge of reporting such rich studies in an examinable and meaningful way.

Below we set out our thoughts on these three issues and invite our fellow researchers in the co-creation in TEL community to consider how we can address them together in future work.

Variations in How Co-Creation Is Interpreted and Enacted in the TEL Community

Co-creation can be considered as a collaborative way of creating and incorporating knowledge in the new knowledge-based, service-oriented economy. Co-creation is all about collaborative knowledge creation. It is the evolving method from communities of practice to innovative knowledge communities [16]. It fosters both the rapid development and implementation of new ideas from small groups to bigger communities, but it also democratizes the decision-making process that drives this knowledge from the abstract to tangible real-world products and services.

Valuing and involving community members' experiences is the key to meaningful co-design. Parallel meaning making processes, however, can result in conflicts of interest. These can result from controversies in practical needs, technical limitations and theoretical guidance, for example. We still need to find ways of handling this collaborative knowledge creation and decision-making process in a democratic way leading to trust in the design team lead. One proposal includes finding a design team lead, neither being driven by practical, scientific or business needs, that coordinates requirements, experiences and opinions between the diverse stakeholders to arrive at the most meaningful outcome for everyone. This person might even be required to coordinate controversial positions in the design team, taking unfavourable decisions and not losing the overall design goal out of sight. It needs a neutral person that sits in the driver's seats for the sake of the team goal.

Co-creation is a great opportunity for crowdsourcing content, along with value as well as creating knowledge and content in an organic manner that does not require shifts from the usual practices. Such a model supports emergently the collaborative creation of knowledge and it is a great facilitator for educating young learners both in topical knowledge and in soft skills such as collaboration, communication and social as well as self-regulation.

Conceptually, co-creation, as a theoretical framework of collaborative knowledge-building [15, 17,18], has to reconcile itself with the practical considerations of co-design, which focus on collaborative creativity at the maker's level. Furthermore, these terms need a solid definition regarding its scope, in the context of TEL. Is the design of a novel TEL course a co-design or a co-creation endeavor? Is the crowdsourcing of iterative content development in TEL a co-design task or just simple implementation and/or remixing of pre-existing design artifacts?

The Complexity of Co-Creation and How to Manage It

These questions are exacerbated even more by the inherent complexity of research in the specific area. Co-design field work can be daunting to nail down in research outcomes because, by its nature, it is organic, open-ended and thus difficult to analyze and report in succinct scholarly communication. This necessarily leads to qualitative methodologies for observation and analysis, integrating stakeholder, domain, design and theory perspectives.

The organic, integrative complexity of co-creation research presents challenges for its overall traceability and trustworthiness. This mainly relates to the internal validity as the often-applied qualitative field studies usually score higher on external validity. This is illustrated in the following examples. Due to scarcity of resources, time limitations or practical necessities for example, all relevant stakeholder groups cannot be involved in each and every co-creation step. At times, co-creation can lead to ad-hoc solutions that do in fact work, but the dynamics of the process do not cater to the analytical dissection of the processes which is required for rigorous recording of relevant steps that lead to that solution. Additionally, at this same process, there can be a case where the dynamics of co-creation call for a temporary dissolution of the

collaborative process and focus on pure expert technical work, a fact that jeopardizes the research process for the whole methodology.

The Challenge of Reporting Co-Creation Studies in an Examinable and Meaningful Way

The mainly qualitative character of co-creation studies requires extended discourse to develop its arguments in a rigorous way. Furthermore, co-creation is a developing research area in TEL, which means that it does not yet have a commonly accepted reporting structure. Thus, papers written about such studies can often be longer than the standard journal length. There may be a need for the research community to find and agree on a standard way of reporting such research results in precise, concise and consistent manner.

Co-creation activities cannot always implement research schedules with the same internal uniformity as other areas of research given the widely diverse nature and format that their iterations can take, as illustrated in the submissions of this special issue. The highly interdisciplinary nature of this research area (co-creation and TEL) also means that a range of methodologies are in use since the researchers have backgrounds and training in different disciplines. Thus, we feel there is a need for greater clarity within studies regarding the ontological perspective being adopted and the methods being used, to help alleviate any concerns of internal validity that sometimes linger over design studies. Methods in use within this research area can include in depth thematic content analysis (adopting an interpretative approach to qualitative data), combining qualitative and quantitative research results (mixed methods) or quantifying qualitative co-creation research results In proposing greater clarity about which perspective and methodology is being adopted we are not claiming that one methodology is superior to others, but are merely arguing that such clarity can help to ensure traceable results and support meaningful interpretation and discussion of these results by researchers from the different disciplines.

In conclusion, this special issue includes a series of high-quality studies that aim to put into perspective the theoretical tenets of co-creation and co-design, through the lens of evidence based qualitative and quantitative methods, in the field of technology enhanced learning. The work reported demonstrates the growing interest and expertise in co-creation within the TEL community and helps us identify where further work, including both studies and discussions within the community, can be usefully undertaken.

Acknowledgements. We would like to thank the reviewers of this special issue for their support and their constructive reviews of the submitted papers. Twenty-nine papers were submitted to this special issue and a double-blind review process was followed with at least two reviewers being assigned to each paper. The authors of accepted papers were asked to respond to the reviewers' comments and the Guest Editors took the final decision regarding publication. The reviewers' insightful feedback to authors therefore had a great impact on this special issue and we thank them very much for their contribution.

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