After the Study Ends: Developing Heuristics To Design for Sustainable Use of Learning Technologies in Classrooms

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ABSTRACT

A central challenge of developing learning technologies for K-12 classrooms is designing for *sustainable use* – ensuring that the technology has a lifespan in the classroom beyond the term of a research project or implementation period. This half-day workshop aims to bring together designers, researchers, and educators creating K-12 learning technologies to share and reflect on the challenges and opportunities of designing for sustainable use in classrooms. In the workshop, we seek to develop a set of heuristics to guide designers and provide a context for designing for sustainable use. By sharing the outcomes of this workshop we hope to develop a common language, design goals, and examples of successes and challenges in designing for sustainable use.

CCS CONCEPTS

• **Social and professional topics → Children**; • **Human-centered computing → HCI theory, concepts and models**.

KEYWORDS

children, learning technology, sustainable use

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Note: This workshop is offered in conjunction with ***Embedding digital technologies in the school practice: Schools as agents of technology integration*** *to form a full day workshop exploring both the technical characteristics and the contextual factors of sustainable integration of learning technologies in schools.*

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1 BACKGROUND

A core challenge facing educators and designers is how to design curricular innovations that can become sustainable and useful in the long term in the classroom. We define *sustainable use* as an innovative learning technology gaining a lasting place in a classroom such that an educator utilizes the learning technology regularly long after the research ends or the development team leaves [6]. Designing learning technologies for sustainable use in classrooms has been studied for many years [3, 5, 6, 8], and there is a variety of research which develops frameworks for understanding the challenges of sustainable use given the political, organizational, and socio-cultural context of an implementation [2, 7]. Fishman et al. [2003] identify the concept of "usability" from the field of human-computer interaction to ensure that a tool is adaptable to an organization's context such that the organization can enact the innovation successfully [6]. Research on co-design offers insights into one way to design for this kind of adaptability [1]. Still, the usability of a tool is relative to its implementation context and is highly variable across technologies and across implementation contexts. Fishman et al. [2003] note that "we need to refine a language for describing our work with each other, in order to promote understanding of the challenges we encounter" [6].

One way to respond to this need is to identify and examine specific technical features that have contributed to the sustainable use of a learning technology to understand whether this feature could be utilized in other contexts. Through this process of examination and abstraction, we can develop heuristics which designers and practitioners can use to guide their work developing learning technologies. Here, we use the term *heuristics* (rather than *principles* or *goals*) to leverage the implication that heuristics are intended to guide a co-design process rather than dictate its goals [4].

The goal of this workshop is to bring together designers, researchers, educators, and developers who have been developing and researching K-12 learning technologies to share and reflect on the challenges and opportunities of designing for the sustainable use of their technologies in classrooms. Together, we will derive high-level heuristics illustrated by practical examples of design features and the problems they address which can guide the design of learning technologies in various contexts.

2 ORGANIZERS

Our interest in developing these design heuristics comes from our own work building the MoDa learning technology. MoDa is an integrated domain-specific computational modeling environment that enables building of agent-based models and comparing them with data of scientific phenomena. Throughout the development of this tool, we have engaged with partner teachers in a co-design process which has allowed us to adapt the design of the platform to the needs of our partner teachers and end users, students. One example of a heuristic for sustainable use we've identified from this work is to reveal new layers of abstraction over time to allow learners to return to a learning activity at deeper and deeper levels of complexity. To do this, we have designed the MoDa coding platform to allow learners to optionally "unpack" a piece of code to see and manipulate what that code is doing at a deeper level.

Jacob Wolf is a research associate at Teachers College, Columbia University in the Transformative Learning Technologies Lab. His work focuses on designing learning experiences that promote the development of youth computational cultures through the integration of computational literacy into STEM classrooms and beyond.

Dr. Tamar Fuhrmann is a senior research scientist at Teachers College, Columbia University. She leads research projects at the Transformative Learning Technologies Lab and the FabLearn Program. Her work focuses on developing classroom technologies for learning to examine ways to integrate STEM and constructionist activities into the school curriculum.

Dr. Aditi Wagh is a Research Scientist in the Scheller Teacher Education Program at the Massachusetts Institute of Technology (MIT). She employs design research methods to design learning technologies and experiences that integrate computation and STEM to build on children's existing ways of knowing and experiencing the world to promote learning.

Adelmo Eloy is a research fellow at Teachers College, Columbia University in the Transformative Learning Technologies Lab, and a doctoral student in Electronic Systems at the University of São Paulo (USP), in Brazil. His work focuses on the design of learning technologies for K-12 STEM Education.

Dr Paulo Blikstein is an Associate Professor at Teachers College, Columbia University. He has designed educational platforms for rich experimentation and developed the Bifocal Modeling framework as well as other cutting-edge techniques in learning analytics.

Dr Michelle Wilkerson is an Associate Professor at the Graduate School of Education at the University of California, Berkeley. She studies how young people learn with and about computational representations such as computer simulations, data visualizations, or interactive graphics.

3 PRE-WORKSHOP PLANS

Our intended audience encompasses participants who have worked on or are currently working on learning technologies for use in classrooms including designers, researchers, educators, and developers. In particular, we will welcome applications from teams working on a technological innovation. To garner interest in this workshop, we will reach out to previously established networks on K-12 STEM Education (e.g. Community for Advancing Discovery Research in Education (CADRE), Center for Integrative Research in Computing and Learning Sciences (CIRCLS), Special Interest Groups within the American Educational Research Association (AERA)) as well as groups in our respective institutions. Additionally, we will advertise the workshop to a broader audience using social media platforms (Twitter, Facebook, LinkedIn). We will use the following website to host information about the workshop: https://sites.google.com/tc.columbia.edu/a2s-idc-2022/home

4 WORKSHOP STRUCTURE

The workshop will include the following sections:

- Introduction (10 min)
- Case study talks by organizers and participants (5-7 min each, 60 min total)
- Breakout group #1: Categorize sustainable features of technologies (30 min)
- Breakout group #2: Adapt & build on prior categorization (30 min)
- Group share outs and discussion of heuristics for sustainable use (30 min)
- Wrap-up and reflection

After a short introduction of workshop focus, participants (or groups of participants from the same project) will present a case study of their learning technology. Each case study will provide an overview of the technology and highlight specific design features which promote sustainable use as well as what motivated these features during the design process.

Following the case studies, participants will divide into breakout groups for an in-depth discussion of each case study. Group's will discuss design features in more detail and cluster examples of design features by similar goals. For example, a goal might be to allow teachers to follow students' learning trajectories over time. One feature that supports this goal could be a dashboard showing student progress while another might be capturing student reflection on their learning at various times. Through small-group discussion, each group will generate a collection of heuristics for the design of sustainable use of learning technologies. Participants will then join new small groups to adapt and build upon their initial categorizations, integrating the perspectives of their new group with those of their initial group.

Next, all participants will reconvene to share out and discuss their design heuristics. As the group reaches a coherent framework of heuristics, we will also identify salient examples of the way a heuristic has been applied in various technologies.

5 POST-WORKSHOP PLANS

We will use the documentation of this workshop to develop a report on the design heuristics for sustainable use with the intention of publishing the findings in a peer-reviewed conference or journal. Participants of the workshop will be included as contributors and also given the option to be actively involved in the authorship of the report. Additionally, to make these findings more accessible to designers, educators, and developers actively building learning technologies, we will also turn the design heuristics for sustainable use into a digital guidebook which will be freely available online.

6 CALL FOR PARTICIPATION

A central challenge of developing learning technologies for K-12 classrooms is designing for *sustainable use* – ensuring that the technology has a lifespan in the classroom beyond the term of a research project or implementation period. This half-day workshop brings together designers, researchers, and educators creating K-12 learning technologies to discuss the challenges and opportunities of designing for sustainable use in classrooms and to develop a set of heuristics to guide this process. By sharing these heuristics with researchers and practitioners, we hope to develop a common language, design goals, and examples of successes and challenges in designing for sustainable use.

We invite participants to submit 1-2 page case studies of a learning technology they have developed or are actively developing. Case studies should provide an overview of the technology explaining its functionality as well as its learning goals, intended users, and implementation context. The case study should also highlight specific design features which promote sustainable use as well as the successes and challenges of implementing the technology in classrooms. We encourage participants working on a technology together to apply as a group. At least one author of each accepted paper must attend the workshop. All workshop participants must register for both the workshop and the main conference. Application and more information here: https://sites.google.com/tc.columbia.edu/a2s-idc-2022/home.

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