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A Toolkit for Action: Translating Theory into Practice

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Abstract: Educators are increasingly being asked to promote 21st century skills in their digitally-enhanced classrooms, supporting students' development of critical and creative thinking, problem-solving skills, and to learn to collaborate as productive members of an increasingly netwoked society. Educators, tasked with the oversight of increasingly active and digitally-enhanced learning spaces, are in need of practical methods and tools capable of supporting theoretically informed practices in design for learning. In this paper, our aim is to translate recent theoretical developments in the learning sciences into methods and tools for action, in order that the rich opportunities for learning that these spaces offer, do not go to waste. Central to this research, is the need for analytical tools that facilitate conversations about learning theories and design practices, between different members of increasinlgy diverse educational design teams. The paper introduces A Toolkit for Action, as a tool and a method for mediating conversations about designing for learning in the digital age.

Keywords: Design for Learning, Embodied Cognition, Distributed Cognition

1. Introduction

Teaching in the 21st Century requires that educators (re)design tasks that help students develop critical and creative thinking, problem-solving skills, and an ability to work as a productive member of a team—to learn to collaborate (Johnson et al, 2015). Schools across the globe are changing, as students are recast as active creators and not passive recipients of knowledge. These transformations occur not only in *how* people teach, but also in *where* they teach, as learning spaces are altered to accommodate different forms of innovation. Our research draws on theories of embodied cognition (Clark, 2010; Kirsch, 2013), entanglement (Hodder, 2012), the materiality of learning (Sørensen, 2009), and pattern languages (Alexander et al., 1977); as well as on methods from design anthropology (Gunn et al., 2013), design thinking (Brown and Katz, 2011), and the learning sciences (Carvalho and Goodyear, 2014; Carvalho et al., 2017). We argue that in order to develop successful computer-supported teaching and learning practices—in innovative learning spaces—we need to understand how productive learning activity emerges through the interplay of people, materials (both physical and digital) and task design. Educators tasked with the oversight of increasingly active and networked learning spaces, are in need of practical methods and tools capable of supporting theoretically informed design for learning. Our aim is to translate recent theoretical developments in the learning sciences into methods and tools for action, in order that the rich opportunities for learning that they offer, do not go to waste. Our research question focuses on: *How do we facilitate productive conversations, about theory and design, between different members of increasinlgy diverse educational design teams*? We introduce the Toolkit for Action—both a method and tool for mediating conversations in educational design teams. Produced primarily as a set of cards, the toolkit acts as a translation device (Bernstein, 2000) to facilitate the process of bringing educational theory into educational design practice. In the next section, we introduce ideas from design and sociology, explaining the need for analytical devices to mediate knowledge discourse in educational design. We then discuss how the toolkit enacts ideas in the Acitvity-Centred Analysis and Design framework (Carvalho and Goodyear, 2014), before exploring how learning theories, such as embodied and distributed cognition, shed light on the role of things in thought and action—in learning. We describe the methods and the design of the toolkit, and outline our vision for

its future development and how it supports knowledgeable action, in learning design and the orchestration of learning activity.

2. Bringing Ideas from Design & Sociology into Design for Learning

Design projects often bring people from varied disciplinary backgrounds together, such as architects, engineers, builders and clients. Each set of stakeholders has idiosyncratic ways of seeing and speaking about design. But for successful collaborations to emerge designers need to find common ground in which to articulate their ideas (Carvalho et al., 2009), in order to develop a shared understanding of what is to be achieved. In these scenarios, no single actor is likely to possess all the knowledge necessary to realize a design, and it is only through conversations about different design ideas that a team can achieve a shared understanding of the best way to tackle a specific problem (Kleinsmann et al, 2012; McDonnell 2009). As such, a team's effective engagement in processes of knowledge sharing is crucial to successful collaboration. Conversational Turns is a method used by McDonnell (2009) in the analysis of design conversations by a team of architects and building-users, as they engaged in collaborative design. The method helps in tracing the progression of design as a collaboratively negotiated task. Sequences of interaction in design meetings can be examined, and episodes of knowledge sharing and knowledge integration can be identified in the conversational setting of design tasks. Both knowledge sharing and knowledge integration are interconnected processes, established by the turns taken in conversations. In Conversational Turns, a series of tentative movements are identified, starting with someone explicitly acknowledging a position or knowledge put forward by another person in the team, and then using this proposition to recommend or justify a design decision, which in turn incites an expert response or confirmation (Keinsmann et al, 2012; McDonnell, 2009). Similarly to the design field, educational design also often involves mixed arrangements that bring together stakeholders from diverse backgrounds – for example, educational managers, space planners, teachers, instructional designers, students. Likewise in design, all of these stakeholders might bring diverse ways of looking at an educational design task. Educational designers exchange ideas about the creation knowledge artefacts for learning – discussing, thinking about, planning the use of, and developing artefacts for educational practices related to the production, recontextualization, teaching and learning of knowledge. Building on Basil Bernstein's code theory and on Pierre Bourdieu's field theory, Legitimation Code Theory (LCT) (Maton, 2014) acknowledges knowledge as both: (a) socially constructed, within cultural and historical conditions, and (b) as something in its own right, something that may take different forms and have diverse effects on educational practices. Knowledge claims tend to vary according to social contexts, and knowledge practices reflect implicit 'rules of the game' that operate in (and are specific to) these, affecting and shaping the way knowledge is expressed or communicated (Maton, 2014). On that view, an educational team is likely to bring together people who all practice design – a space planner, a principal, and a maths teacher – who may have different underlying rules for knowledge practices in design. They will bring these to conversations, as their perspectives will be grounded in particular ways of seeing and valuing knowledge. Our Toolkit for Action was designed as a translator device—bringing educational theory into design conversations—to facilitate processes of knowledge sharing and knowledge integration, in the context of the work done by educational design teams. Before illustrating how the kit supports these knowledge conversations, we introduce ACAD, a second theoretical framing that highlights different 'topic areas' of productive design conversations.

2.1 The Activity-Centred Analysis and Design Framework (ACAD)

The ACAD framework sees learning as socially and physically situated, but also as powerfully shaped by epistemologies of learning (Goodyear and Carvalho, 2014). ACAD foregrounds activity—or what learners do—as central in any given learning situation; and learning situations are conceptualised as structural compositions of tools, tasks and people. Aspects of learning that are open to adjustment—*the designable components*—are refered to as set, epistemic and social designs. In making the distinction between what is open to alteration and what is not, ACAD describes the activity of learners as emergent. Goodyear's earlier (1999) work on pedagogical frameworks and Alexander's work on Pattern Languages (1977) reveals multiple scale levels at which design can influence those things that are open

to adjustment. Building on these ideas, Yeoman (2015) created a three-by-three *wireframe* (Table 1) where concepts from the ACAD framework simultaneously converge in a horizontal correspondence across the three dimensions (set, social and epistemic), as well as a vertical correspondence at three different scale levels (the detail or micro, the regional or meso, and the global or macro). Yeoman's *wireframe*, lays out a way in which ACAD, Pedagogical Framework and Pattern Languages may be brought together to connect observations of materials in use, with different dimensions of design, and in so doing, it helps designers to account for what constitutes good design for learning. The *wireframe* acts as the backdrop for the translation device (Bernstein, 2000) that helps designers navigate between theoretical concepts and their practical enactments. One of the ways the *wireframe* does this is by supporting the fine-grained analysis of one element (smartphone) of one dimension (set), as it is enrolled in emergent learning activity—without losing sight of elements of the other dimensions at multiple scale levels. Next, we introduce two theoretical perspectives – embodied and distributed congnition, arguing that the use of knowledge artefacts may facilitate educational design activity – to mediate conversations, as well as to encourage collaboration. These theories claim that material things help humans think differently, and provide a rationale for how cards might help in thinking about tools, tasks, and people in design for learning.

Table 1: The ACAD wireframe

	SET	SOCIAL	EPISTEMIC
Micro	*Artefacts, tools & texts*	*Roles & divisions of labour*	*Selection, sequence & pace*
Meso	*Allocation & use of space*	*Community*	*Curriculum*
Macro	*Buildings & technology*	*Organisational forms*	*Stakeholder intensions*

3. Lessons from Embodied & Distributed Cognition: Using Cards to Think

Embodied cognition speaks of extension of minds beyond bodies, to include tools, symbols, artefacts that mediate interactions in the world (Clark, 2010), where "the concepts and beliefs we have about the world are grounded in our perceptual-action experience with things, and the more we have tool mediated experiences the more our understanding of the world is situated in the way we interact through tools" (Kirsh, 2013, p. 3:3). In other words, cognition grounds our behavior and is influenced by our perceptual system, where alignment between our actions and predictions that we make about the environment co-evolve (Markauskaite and Goodyear, 2017). Design thinking has embraced ways of understanding culture and context through learning by doing – where *making* is an integral part of the process, and *prototyping* is as an activity that speeds up the design process (Brown and Katz, 2011). Design thinking also has a participatory character, one in which bouncing ideas around and exchanging experiences are key. We argue that the toolkit encourages designers to participate in practices that are representational *and* embodied. What is more, that by their very nature—as knowledge artefacts—the cards support the distributed knowledge practices of interdisciplinary design teams. Distributed cognition (Hutchins, 2014) is not another descriptive theorization of how it is we come to know. Rather, it asserts that all cognition is distributed and emerges from distributed processes. As Hutchins (2014) reminds us: "wherever we find cognition, it will be possible to investigate how a process we call cognitive *emerges* from the *interactions* among elements in some system"(p. 36). This way of theorizing resonates well with our research, and helps explain why people find working with the help of cards, supports design for learning, where no single person can attend to or resolve the complex interplay of set, social and epistemic design, across multiple scale levels.

4. Research Methods

The playful way in which we encourage people to work the cards does not rest on theory alone, but draws on methods used in design anthropology. Design anthropology is an emerging field that combines the forward orientation of design with the retrospective strengths of anthropology. Knowledge production in design anthropology differs from traditional ethnography in that their use of theory goes 'beyond analysis and description to the generation of design concepts' (Otto and Smith, 2013). Working

collaboratively, for extended phases, design anthropologists help to generate and refine concepts (Drazin, 2013), and explore different styles of knowing (Kilbourn, 2013) using non-textual tools (e.g. perceptual synthesis, experience juxtaposition and others). An array of artefacts, images, craft supplies and construction toys can be used in the joint resolution of a shared problem/challenge. Our Toolkit for Action is grounded on the analysis of participant observation, field notes, and video and photographic records of design activity, conversations and artefacts from five Workshops, where participants used the cards as a medium to engage in design conversations.

5. A Toolkit for Action: Bridging Conversations about Theories & Practices

5.1 An Analytical Tool for Mediating Conversations

Based on tools from design anthropology (Gunn et al., 2013), and building on the research of Carvalho (2010), Chatteur (2011) and Yeoman (2018, 2015), we created our Toolkit for Action as a way to facilitate the enactment of theoretically informed educational design practices. We envisaged the toolkit as a tool for teams—an aid to stimulate processes of knowledge sharing and knowledge integration (McDonell, 2009) by supporting educational designers reach a shared understanding of design for learning, through mediated conversations. In its current form, the kit has four main elements: (1) a set of cards, (2) a set of artefacts, (3) three learning scenarios, and (4) the ACAD wireframe. The full kit includes 93 cards, distributed across four dimensions of design, with each assigned a specific colour. Blue cards (Figure 1) are associated with theoretical concepts and high level philosophy (Goodyear, 1999). They are presented in two sub-types. The first displays the names of learning theories and their principal authors, and the second offers quotes selected to prompt reflection and discussion about learning. The remaing three sets of cards are associated with one of the three dimensions of design, as defined in ACAD (Carvalho and Goddyear, 2014). Green cards offer headline terms associated with *set design* (space, place artifacts, tools and texts), such as **collaborative learning studio**, **pen and paper**, **laptop**, and **Learning Management System**. Second order terms on the Green cards include key words describing qualities of the named element. For example, the first order heading **smartphone** is described, in second order headings, as (in)formal, dynamic, blended. By this we mean to convey that a smartphone can be considered a tool for learning in both formal and informal settings, that it supports a dynamic or decentralised form of learning activity, and it facilitates blended learning. Yellow cards offer headline terms associated with *epistemic design* (task design), basic task structure such as **pace** and **mode of delivery**, **content selection**, and **assessment**. The second order headings on these cards simply identify them as, structure. Yellow cards also refer to task type, such as **problem solving** or **game playing**. The second order headings on these cards suggest broader sets of instructional forms. For example, **problem solving** is described as indirect instruction, whereas **game playing** is described in terms of experiential instruction. Orange cards offer headline terms associated with *social design* (individuals, groups, roles, divisions of labour), such as **team** or **assigned roles**. The second order headings on the organge cards differentiate between social-identity (**the next user**), social-instruction (**scripted roles**), social-shape (**pairs**) and social-responsibility (**facilitator**).The Blue cards were specially designed to initiate theoretical conversations and to stimulate processes of *knowledge sharing* (McDonnell, 2009). They encourage people to share a particular viewpoint about a high level philosophy, and invite others to respond to that viewpoint by adding their own views to the mix. The Green, Yellow and Orange cards also encourage *knowledge sharing* in relation to epistemic, social and set design. Moreover, in combination with other artefacts, such as the wireframe, the cards encourage processes of *knowledge integration* by providing an opportunity to test how different components of each dimension (set, social and epistemic) correspond or conflict with design choices and constraints of design across various scale levels (macro, meso and micro). This type of *knowledge integration* is further supported through the use of artefacts to represent the alignment of individual knowledge to a shared-like orientation, for example with a mix of butcher's paper, stationary tools, or other artefacts. Current artefacts in the toolkit include photographs of various learning environments, floorplans, and an assortment of 2D and 3D architectural representations of different modes of use. It also includes three learning scenarios, carefully scripted and based on previous research conducted in museum, university and school settings (Carvalho, 2010; Carvalho and Garduno-Freeman, 2016; Yeoman, 2015).

They offer educational designers authentic designs, which they can re-present using the cards. In this way, those unfamiliar with learning design or ACAD can focus on the dimensions of design, and the coherence or dissonance between dimensions and scale levels, without having to create an entirely new learning design in the process. In addition to these curated artefacts, the kit would be decidedly less generative without a healthy supply of various resources that encourage collaborative design activity, such as Post-it notes, blank Artefact Cards, markers and butcher's paper.

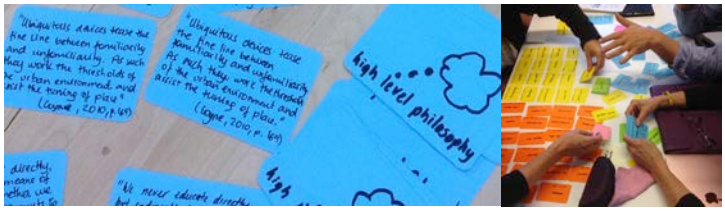

Figure 1: Blue Cards (left) and Cards in Action (right)

5.2 A Method for Using the Toolkit for Action

The toolkit is to be used in three complementary, but independent stages, which can be quickly adapted to refelct the skills and needs of an educational design team by, for example, selecting a subset of cards, or creating customised cards to scaffold a specific brief. *Stage 1* is about *Learning to Bring Theory into Practice,* and is designed to scaffold the use of the cards. At this level, educational designers learn how to use the cards with the help of the ACAD wireframe. The focus is on creating shared consensus about the learning theory at play, before documenting a clear articulation of that theory, and tracing its correspondence or dissonance across dimensions of design and scale levels. *Stage 1* workshops are appropriate when working with inexperienced educational designers, with newly established teams, where time is limited, and in the early stages of learning environment (re)development or curriculum renewal. *Stage 2* is about *Bringing Theory into Design Practice* and is designed to give educational designers an opportunity to work on a design challenge that is specific to their current context. It could be the (re)design of a particular unit of study or a new learning space. Some team work is aspirational, whilst others work hard to meet the challenges of a tight design brief and or limited budget. Either way, participants are encouraged to start with the Blue cards so that their work is theoretically grounded. They are then free to engage with the other cards and artefacts in a way that meets their needs. In *Stage 2* the focus is on identifying those elements of each dimension that are both open to design, and within participants' sphere of control to influence—with the express intention of increasing the coherence of the learning whole. *Stage 2* workshops are appropriate when working with existing teams or experienced educational designers on projects with personal relevance. *Stage 3* is about *Refining the Design and Orchestration on the Fly* and is designed to offer designers time to reflect on and improve an existing design. Participants in *Stage 3* workshops learn how to use the ACAD wireframe to analyse a particular moment of learning activity, or how the use of a given tool shapes learning activity. *Stage 3* focuses on iterative improvement and adaptive flexibility in future implementations of an existing course. *Stage 3* workshops are appropriate for educational designers wanting to reflect on and improve their current teaching and learning practice, and for teams tasked with post occupancy evaluations of new learning spaces.

6. Conclusion & Future Research

As innovative digitally-enhanced learning spaces become common place, a broader cross section of educational designers will be required to engage in increasingly complex design projects. Finding ways to facilitate communication amongst diverse educational design teams is critical, if successful collaborations are to emerge through shared understandings of how to tackle complex problems. This paper introduces a method and a tool to support educational designers conversations, in a way that brings learning theories into the design scene. Ideas from sociology, design thinking, embodied and distributed cognition ground the creation of the Toolkit for Action (Carvaho and Yeoman, forthcoming). Our future research goal is practical, to continue to analyse our data and fine tune a set of 100 cards that can be scaled down by thirds across dimensions of design, without loosing functionality, and to develop

further scaffolds to assist instructional designers in resolving design challenges across a number of areas, including environment design, assessement design and innovative social designs. To do this we will continue to sistematically explore the use of the toolkit with teams of designers, gathering relevant data to help us refine its design, artefacts and methods for use. We anticipate that through this process, and in gathering feedback from participants we will transform the Toolkit for Action into a universal method and tool.

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References

Alexander, C., Ishikawa, S., Silverstein, M., Jacobson, M., Fiksdahl-King, I., & Angel, S. (1977). A pattern language: Towns, buildings, construction. Oxford University Press.

Bernstein, B. (2000). Pedagogy, symbolic control and identity. Rowman & Littlefield Publishers.

Brown, T., & Katz, B. (2011). Change by design. *Journal of Product Innovation Management*, 28(3), 381–383.

Carvalho, L. (2010). A Sociology of informal learning in/about design. PhD Thesis, The University of Sydney.

Carvalho, L., Dong, A., & Maton, K. (2009). Legitimating design: A sociology account of the field. *Design Studies*, 30(5), 483-502.

Carvalho, L., & Garduno-Freeman, C., 2016. CmyView: Walking together apart. *10th International Conference on Networked Learning*, 9-11 May, Lancaster, United Kingdom.

Carvalho, L., & Goodyear, P. (Eds.) (2014). The architecture of productive learning networks. Routledge.

Carvalho, L., Goodyear, P., & De Laat, M. (Eds.) (2017). Place-based spaces for networked learning. Routledge.

Carvalho, L., & Yeoman, P. (forthcoming). Learning to teach in innovative learning spaces: A toolkit for action. Routledge.

Chatteur, F. (2011). Design for pedagogy patterns for e-learning. PhD Thesis, The University of Sydney.

Clark, A. (2010). Supersizing the mind: Embodiment, action and cognitive extension. Oxford University Press.

Drazin, A. (2013). The social life of concepts in design anthropology. In W. Gunn, T. Otto, & R. C. Smith (Eds.), *Design Anthropology: Theory and Practice* (pp. 33–50). Bloomsbury Academic.

Goodyear, P. (1999). Pedagogical frameworks and action research in open and distance learning. *European Journal of Open and Distance Learning*. Retrieved 17 May, 2017, http://www1.nks.no/eurodl/shoen/goodyear/index.html

Gunn, W., Otto, T., & Smith, R.C. (Eds.) (2013). Design anthropology: Theory and practice. Bloomsbury.

Hodder, I. (2012). Entangled. Wiley-Blackwell.

Hutchins, E. (2014). The cultural ecosystem of human cognition. *Philosophical Psychology*, 27(1), 34-49.

Johnson, L., Adams Becker, S., Estrada, V., & Freeman, A. (2015). NMC Horizon Report: 2015 K-12 Edition. The New Media Consortium.

Kilbourn, K. (2013). Tools and movements of engagement: Design anthropology's style of knowing. In W. Gunn, T. Otto, & R. C. Smith (Eds.), *Design Anthropology: Theory and Practice* (pp. 68–82). Bloomsbury.

Kirsh, D. (2013). Embodied cognition and the magical future of interaction design. *ACM Transactions on Computer-Human Interaction*, 20(1), 3:1-3:20.

Kleinsmann, M., Deken, F., Dong, A., & Lauche, K. (2012). Development of design collaboration skills. *Journal of Engineering Design, 23*(7), 485-506.

McDonnell, J., (2009). Collaborative negotiation in design: A study of design conversations between architect and building users. *CoDesign 5,* 35-50.

Markauskaite, L., & Goodyear, P. (2017). Epistemic fluency and professional education: Innovation, knowledgeable action and actionable knowledge. Springer.

Maton, K. (2014). Knowledge and knowers: Towards a realist sociology of education. London, UK: Routledge.

Otto, T., & Smith, R.C. (2013). Design anthropology: A distinct style of knowing. In W. Gunn, T. Otto, & R. C. Smith (Eds.), *Design Anthropology: Theory and Practice* (pp. 1–29). Bloomsbury.

Sørensen, E. (2009). The materiality of learning: Technology and knowledge in educational practice. Cambridge University Press.

Yeoman, P. (2015). Habits & habitats: An ethnography of learning entanglement, The University of Sydney.

Yeoman, P. (forthcoming, 2018). The material correspondence of learning. In R. Ellis, & P. Goodyear (Eds.), *Spaces of Teaching and Learning*. Springer.