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Conceptualizing the designs of authentic computer-supported collaborative learning environments in schools

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Abstract
A major perspective within research on computer-supported collaborative learning (CSCL) approaches learning as a cultural practice and considers the implications of this on the way classroom learning environments are designed. Often referred to as authentic learning, many innovative approaches to the design of learning environments come with the intention that practices of the people who are experts in a domain are enculturated by the participating students. Different approaches taken given the constraints of educational settings have led to conceptual fragmentation in this area of CSCL scholarship. Therefore, the dual aim of this research is to advance our understanding of the relevant cultures at play when designing for authenticity and show how these cut across different approaches taken for the design of authentic CSCL environments in schools. Using the constant-comparative method, we looked back at the past quarter century of sociocultural research to analyze the way different variations of sociocultural activities, scenes, participants, time, and cultural tools have been designed within authentic CSCL environments. A refined conceptualization of authentic learning that elucidates the relationships between intended, current, and authentic cultures emerged coupled with a novel coding scheme and visualization tool that can help the field rise above the wide variation in designs for authenticity.

Keywords Authentic learning · CSCL · Design · Enculturation · Sociocultural

Introduction

Bridging the gap between schooling and society has been a major theme and commitment of educational research over the past quarter century (Lee et al. 2016; Sawyer 2014). These ideas

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are often the concern of socioculturally-minded theories, which view learning as enculturation (Brown et al. 1989; Lave and Wenger 1991; Rogoff 2003; Sfard 1998), and corresponding educational approaches such as cognitive apprenticeship (Collins 2006) and classroom learning communities (Bielaczyc et al. 2013). Perhaps no other theory is more explicit about its concern for ways to design educational environments so that students have access to professional or expert practices than that of authentic learning. Authentic learning environments have been designed to better connect what happens in schools with desired practices outside of them (Edelson and Reiser 2006; Cho et al. 2015; Radinsky et al. 2001).

Conceptualizations of authentic learning, as well as knowledge about how to design for it, have come a long way yet still face challenges. If learning is viewed from a sociocultural perspective, the key concern of any computer-supported collaborative learning (CSCL) environment that is designed for authenticity must be as follows: What should be enculturated and how can the intended outcomes be supported? Conceptually, this raises the challenge of understanding the cultures at play. Past research has differentiated between approaches based on an observable set of factors like the setting and the participants, leaving the central concern of enculturation aside. In reviewing scholarship on this topic, we realized that these related conceptual and design challenges could benefit from further refinement. The aim of this research was therefore to (1) advance conceptualizations of the relevant cultures at play when designing for authenticity, and (2) move the conversation forward about how authentic learning environments can be designed.

With an eye towards fulfilling these objectives, we synthesized existing research, taking a pass over a broad, representative set of CSCL environments designed for authenticity found within leading journals of the field. The outcome of this effort contributes a refined framework of key concepts in the design of authenticity in CSCL environments, coupled with a new visual representation of cultural interactions based on different configurations of sociocultural activities, scenes, participants, time, and cultural tools. While advancing notions related to authentic learning, this can also help new CSCL designers (or designers who have become entrenched in a particular set of ideas) to consider the exciting range of possibilities.

Conceptual and design challenges of designing CSCL environments for authenticity

In the following section, we problematize the conceptual and design issues related to designing authentic CSCL environments in schools. Specifically, we draw out some of the conceptual issues related to authenticity and the cultures that are at play, the constraints of designing for authenticity in educational settings, and efforts by educational researchers to think about authentic designs.

Conceptualizing authenticity for CSCL environments

The term authenticity has been appropriated into a range of disciplines with a variety of meanings, both outside and inside education (see De Bruyckere and Kirschner 2016; Kreber et al. 2007; Shaffer and Resnick 1999). In psychological literature, the term authentic is rooted in the relation between a person's feelings and what they communicate outwardly (Bugental 1981). Rogers (1969), calling this idea congruence, suggested this as one of the key features of the fully functioning person. In school settings, he explained that instructors need to remove the facades they wear as educators so that they can be 'real' people who don't know everything, while students can be more authentic by sharing their 'half-baked', emerging ideas.

The sociocultural turn in education did not necessarily abandon this perspective, but moved from a relational focus between a person's inner and outer worlds to a cultural level. Stated differently, instead of seeking congruence *within a person*, sociocultural analyses focus on the *relation between cultures*. The relational understanding of authenticity explains why and how we consider a traditional school setting to be authentic or not, which is an important issue that has been raised and discussed by socioculturally-minded scholars (e.g., Engeström 2009). Measured or compared against itself, anything can be considered authentic. For example, traditional classrooms are authentic versions of traditional classrooms! Yet, as self-relational examples such as this are truisms, they are not useful for analytic purposes.

Radinsky et al. (2001) identified two forms of sociocultural perspectives on authenticity within educational settings. In the first—student-focused conceptions—the school or classroom culture can be compared with the "personal goal-structures and life-worlds of the participating students" (p. 407). Heath (1983), illustrating this conception, documented the way a town school's language and culture mapped very poorly to the language and culture of the students who attended from formerly segregated towns called Roadville and Trackton. Using ethnographic tools, teachers learned to design their instruction in a way that was more authentic to the students' everyday lives.

The second sociocultural view on authenticity focuses on the relation between the culture of the classroom or school and the culture of the adult or professional world. This view was articulated by Brown et al. (1989) in their seminal paper, *Situated Cognition and the Culture of Learning*. Explaining that "too often the practices of contemporary schooling deny students the chance to engage the relevant domain culture, because that culture is not in evidence" (p. 34), Brown et al. suggested that learning environments could be designed to approximate the culture of the people who practice the domain—the authentic practitioners. This sociocultural idea, mixed with a strong emphasis on designing, has been a major and growing focus of CSCL (Edelson and Reiser 2006; Hakkarainen et al. 2013; Lee et al. 2016).

While Brown et al.'s (1989) conceptualization has been a prevailing view of authenticity in CSCL, it offers an inexact vocabulary particularly in relation to culture. This issue was alluded to by Palinscar (1989) in a commentary on *Situated Cognition and the Culture of Learning*:

> What is the mystique of a practitioner's culture that the student must assimilate? In many disciplines, there may be much less of a shared culture than the authors assume. Rivalries and diametrically opposed viewpoints in many disciplines call into question whether a single shared culture exists, or is, in fact, even desirable (p. 6).

Palinscar specifically points to the limitation of Brown et al.'s conceptualization by noting that the authentic practitioner culture may not be uniform and aspects of the culture may not be desirable for classrooms to adopt. For example, there are cases in authentic scientific communities where the undesirable practices of data manipulation occur, and this is unlikely a facet of the authentic culture that teachers would want their students to enculturate. This calls into question the complexity of designing for authentic learning and the need to refine Brown et al.'s (1989) bicultural conceptualization.

Constrains and approaches of designing authentic CSCL environments

The conceptual challenges of designing for authenticity are further problematized when the constraints of educational programs are considered. Specifically, the limited ability for students to have direct, continuous interaction with authentic practitioners over meaningful periods of time is a constraint of educational programs (Lim and Barnes 2005; Timmis 2014). For example, the ratio of newcomers (i.e., students) to old-timers (i.e., teachers) found in classrooms contrasts sharply with learning in professional communities, where cultural maintenance and evolution have a higher balance of old-timers (i.e., established professionals) versus newcomers (Roth et al. 1999). It is already well-established from sociocultural perspectives of learning that "individual and the social world includes individual and environment together in successively broader timeframes from momentary learning, to individual life-course development, to generations in a society, to species history" (Rogoff and Chavajay 1995, p. 871). These distinctions highlight how real-world professional practice comprises of a distinct ecology compared with educational communities, requiring mesogenetic considerations to bridge them sustainably (Cole and Packer 2016). To address some of these differences (Table 1), educational programs require innovative designs to prepare students for life outside of school.

Given these constraints and the ways researchers have thought about culture, authentic learning environments have been designed as taking either a *simulation* or *participation* approach, with the crux of the distinction being conceptualized as to what extent students have direct interaction with the practitioner, as well as in what setting the interactions take place (Cho et al. 2015; Radinsky et al. 2001). Simulations refer to formal educational programs that aim for their culture to more closely resemble, align with, or approximate the authentic culture (Hay and Barab 2001; Hung et al. 2008; Bereiter and Scardamalia 2003). In this approach, the students have limited or no direct interaction with the practitioners of the relevant domain, and predominantly not in their setting. Rather, cultural mediators or boundary objects (Akkerman and Bakker 2011) such as tools and artifacts are introduced to the classroom to "map to the activity of some professional community" (Radinsky et al. 2001, p. 406).

In contrast to the simulation approach, conceptualization of the participation approach provides students with opportunities for direct interaction with practitioners of the culture that the designer intends for their students to enculturate, typically in the context of the professional or expert setting. In such approaches, the student-practitioner interactions are potent cultural mediators, often integrating boundary objects. Stated differently, students learn cultural practices as they engage in apprenticeship-like interactions that are brokered by the professionals themselves in the settings where they practice (Akkerman and Bruining 2016). Even though

Table 1 Comparison of professional and educational communities

	Professional Communities	Educational Communities
Quantity and ratio of participant types	Large membership, making the oldtimer-to-newcomer ratio high. For example, the ratio of a newcomer to a disciplinary community can be 1:1000's.	Small membership, making the individual-to-culture ratio low. For example, the newcomer to old-timer ratio in a classroom can be 30:1.
Continuity and duration	Membership changes gradually. Members enter, often stay for a significant period of time (e.g., career), then leave.	School membership changes rotationally. Members enter, typically stay for several years, then leave; Classroom membership begins and ends together, for a greater part of a year.

the term participation is useful to describe this approach, we emphasize that this is not full participation in the context of designs for authenticity. These interactions are designed within the frameworks of educational programs and are typically regulated by a school instructor, may be limited to working on developmentally appropriate tasks, and/or have time restrictions. As such, we prefer to call them hybrids.

While the prevailing distinction between the simulation and hybrid approaches based on participants and settings appears straightforward, several conceptual problems remain. Regarding participants, should the design of an authentic learning environment in a situation where a classroom teacher is a central participant in an authentic culture be considered a simulation or hybrid? And what if the teacher was a partial participant? Regarding settings, how do you classify configurations where students have direct interaction with authentic practitioners, but this happens within the classroom setting? Likewise, should designs where students enter into a real professional setting, but have limited interactions with the practitioners (such as on a field trip), be conceptualized as a hybrid? These examples of common situations show that considering participants and settings as the main factors may require further theorization.

Beyond participants and setting, there are other important factors relevant in the configuration of authentic learning environments and the cultures that are at play. Here, we draw on Burke (1969) and Polman (2006) who describe five facets of human action: the where/when, who, what, how, and why. The “where/when” refers to the scene of the sociocultural activity, where the acts take place and in what timeframe. We refer to this as the setting and time. The “who” refers to the agents involved in the activities, what we refer to as the participants. The “what” and “how” refer to the specific activities that take place with the cultural tools used to enact them. These can be likened to computer-support and collaborative learning. The “why” in the context of the present analysis refers to the intention or desire of the teacher or designer to create an authentic culture as part of the classroom. The facets of the pentad (Polman 2006) may be irreducible, but analyzing them separately is, as Rogoff (1995) explained, similar to studying the human body—to understand it you can look at a particular organ as long as you do not lose sight of its interdependence with the whole.

Taken together, the pentad provides a way forward to analyze authentic learning environments vis-à-vis the cultures that are at play. The more we can elicit and understand these relations, the fewer variables are left unknown. This leaves us with the ability to design and research the phenomena at higher resolutions. Therefore, the CSCL community could benefit from an analysis of existing CSCL designs for authenticity and their conceptualizations to reduce ambiguities and help the field move its current conversation forward.

Methods used to examine CSCL designs for authenticity

To review existing variations of CSCL designs for authenticity, we collected a corpus of relevant articles and carefully examined the conceptualizations and designs within each of these studies using a constant-comparative method (Glaser and Strauss 1967).

Building a Corpus of cases

To find a representative data set of existing research, we looked for examples of learning environments designed for authenticity within the complete catalogue (first issue through mid-

2017) of the *International Journal of Computer Supported Collaborative Learning* (ijCSCL) and the *Journal of the Learning Sciences* (JLS). These two official journals of the International Society of the Learning Sciences provided a relevant corpus of examples because designs for authenticity has been a major theme within the field (Lee et al. 2016). As the goal of designing authentic learning environments is to enculturate expert practices, we searched for any derivatives of the term enculturation (e.g., enculturative, enculturate, enculturating) within the two journals. Although there were other ways to go about choosing our corpus, this sample proved to be sufficient to create conceptual saturation (Charmaz 2008) that could later be generalized to a wider range of cases. Out of the 43 articles we found, we analyzed only the 23 which included an articulated design for authenticity (see Table 2) which we determined after reviewing the entirety of the article. Because some of these articles have multiple designs, we ended up with 28 different cases. All of our cases included either computer-support or collaborative learning; 20 of our cases included both computer-support and collaborative learning; seven cases, particularly in those studies that pre-dated the establishment of ijCSCL, did not include computer support; one case did not explicitly describe collaborative learning.

Analyzing the cases

Analyzing the data using the constant comparative method involved going through two main stages that included (1) building a conceptual framework and (2) going through our data corpus

Table 2 Full data corpus based on search for authentic CSCL learning environments (ordered chronologically)

Included in corpus Articulated design based on authenticity	Excluded Unarticulated design or lacks design for authenticity
1. Rosebery et al. 1992	Collins and Bielaczyc 1999
2. Brown and Campione 1994**	Barab et al. 1999
3. Gordin and Pea 1995	Barab and Kirshner 2001
4. Magnusson et al. 1997	Barab et al. 2001
5. Roth et al. 1999	Kulikowich and Young 2001
6. O'Neill 2001	Clement and Steinberg 2002
7. Hay and Barab 2001	Suthers and Hundhausen 2003
8. Radinsky et al. 2001**	Kolodner 2005
9. McClain 2002b*	Arnseth and Ludvigsen 2006
10. Barab et al. 2002	Wells and Arauz 2006
11. Kolodner et al. 2003	Dwyer and Suthers 2006
12. Lim and Barnes 2005	Sfard 2007
13. Fischer et al. 2007	Öner 2008
14. Kolikant and Ben-Ari 2008	Hung et al. 2008
15. Lund and Rasmussen 2008	Izsák et al. 2009
16. Zhang et al. 2009	Roschelle et al. 2011
17. Etkina et al. 2010	Song and Looi 2012
18. Chin and Osborne 2010	Stahl 2012
19. Looi et al. 2011	Timmis 2014
20. Berland 2011	Stahl et al. 2014
21. Herrenkohl and Cornelius 2013	Cole and Packer 2016
22. Bielaczyc and Ow 2014	
23. Damșa 2014	
24. DiSalvo et al. 2014	
25. Forte 2015	

*A fuller description of the design was found in a related article by the same author: (McClain 2002a)

**Additions to the original corpus for validation, not found in catalogue of ijCSCL or JLS and applying the conceptual framework to all cases. These steps are roughly equivalent to Charmaz's (2008) notions of grounded theory which starts with coding and memo writing, and proceeds with theoretical sampling and saturation. In this research, the first stage involved identifying key aspects of a design then collaboratively negotiating these characteristics, which often required interpretation and contextual inference, until we reached a consensus view. This entailed going back and forth between our emerging conception and subsequent articles to integrate categories, particularly as we encountered new cases that did not fit the conceptualization we had at that time. During the second analysis stage, we continued this process of refinement until we finalized the tools necessary to identify the design variation from each case we considered. This included going through our entire data corpus to apply our conceptualization, this time independently, before coming together to compare finalized interpretations. In the few cases where there were disagreements, we together re-reviewed the paper and discussed until reaching a consensus view. To validate our final framework, we added two articles that were not in the original catalogue but involved designs for authentic learning. We selected these additional cases based on their accepted and popular conceptualizations of authentic learning as well as their fit with our search criteria outside the original corpus, making them relevant and consequential cases to review (Brown and Campione 1994; Radinsky et al. 2001).

Variations in the designs for authenticity and their conceptualization

In this section, we report on our findings based on an analysis of the cultures we found and the where/when, who, what, how, and why of the cases we identified. We re-emphasize that although the following sub-sections are presented linearly, they were developed concurrently. Still, it is appropriate that we start with the outcomes of our analysis, in the form of definitions, a coding scheme, and visualization tool (section 4.1) before moving on to the specific case-by-case findings (sections 4.2 and 4.3). This allows readers to evaluate the cases using our conceptualization.

Cultures of authentic learning environments and their facets

In our analysis of the cases, we found a large variety of terms and meanings associated with the cultures at play when conceptualizing authentic learning. For example, the culture of a classroom or school that was explicitly designed to be authentic is often referred to as the traditional or conventional schooling culture (Bielaczyc and Ow 2014; Hay and Barab 2001; Looi et al. 2011; Rosebery et al. 1992). Rising above the different conceptualizations, we identified three different cultures that were sometimes undertheorized within particular cases, but relevant and commensurate with every case we examined. These included (a) the *current culture,* a pattern of activities that is developed over time for a community to achieve its valued purposes (Nasir and Lee 2014); (b) the *authentic* culture, the professional or expert culture(s) that the teacher or designer wants the students to enculturate; and (c) the *intended* culture, the teacher or designer's vision or figured world of that authentic culture (Table 3).

In addition to the cultures, our analysis of the pentad across the cases led to a refined operationalization of the different facets of authenticity. Specifically, the following coding scheme (Table 4) and visual representation (Fig. 1) help differentiate between the facets of the pentad in traditional schooling (non-authentic designs), designs for authenticity, and participation in current cultures.

t3.1	**Table 3** Relevant cultures when designing for authenticity	
t3.2	Culture	Detailed description of cultures
t3.3	Current culture	Classroom culture not designed for authenticity: This is a classroom that does not explicitly design for its students to enculturate the practices of practitioners or experts in an intended domain.
t3.4		Classroom culture designed for authenticity: This is a classroom where the culture is designed for its students to enculturate the practices of practitioners or experts in an intended domain. This culture will, in all likelihood, have practices that more closely resemble those of the practitioners or experts in an intended domain compared with traditional classrooms.
t3.5		Professional culture: This is the culture of practitioners or experts in a domain.
t3.6	Authentic culture*	This is the culture of practitioners or experts in a domain only when a classroom design is based upon it.
t3.7	Intended culture	This is an imagined culture that the teacher is a representative of, in a classroom that is designed to be authentic.

*Based on our definitions, all authentic cultures are current cultures; however, not all current cultures are authentic cultures

The visual representation (Fig. 1) includes a symbolic system showing the relationships between the current, authentic, and intended cultures. Taken together, it represents the participation structures of traditional schooling (left), direct participation in authentic cultures outside of school (right), and the gap between them that is filled by designs for authenticity (middle). To be clear, this is *not* a continuum; rather, it shows three qualitatively different categories relevant to the discussion on designing authentic learning environments. The focus of our case-by-case analysis is on elucidating the two different sub-categories (simulation and hybrid) within the "Designs for authenticity" category (middle section of Fig. 1). Still, having a coding scheme and visualization that could explain designs for authenticity with the same

t4.1	**Table 4** Coding scheme of the possible variations within simulation or hybrid approaches		
t4.2	Criteria (Pentad)	Code	Description
t4.3	Participants	P_0	Teacher
t4.4	Who do the students have interactions with?	P_1	Non-authentic practitioners*
t4.5		P_2	Authentic practitioners*
t4.6	Setting	S_0	Classroom
t4.7	Where do significant outside-the-classroom	S_1	Non-authentic setting(s)
t4.8	interactions take place?	S_2	Authentic setting(s)
t4.9	Time	T_0	Educational timeframe
t4.10	What is the continuity and duration of the interactions?	T_1	Authentic timeframe limited by educational timeframe
t4.11	Computer support	CS_0	No or little meaningful computer support
t4.12	Was learning mediated by computational technologies?	CS_1	Computer support
t4.13	Collaborative learning	CL_0	No or little meaningful collaboration
t4.14	Was learning collaborative and between whom?	CL_1	Collaboration among classroom participants (students, teachers) without the addition of outsiders
t4.15		CL_2	Collaboration among classroom participants (students, teachers) with the addition of outsiders

*We consider these as additions to the teacher role. For example, a math teacher who is not an expert mathematician is a P_0, even though the teacher him/herself may also be a P_1. We would only consider a teacher's dual role as a teacher and practitioner if this was an intentional part of the design (see, for example, simulation variation A, below)

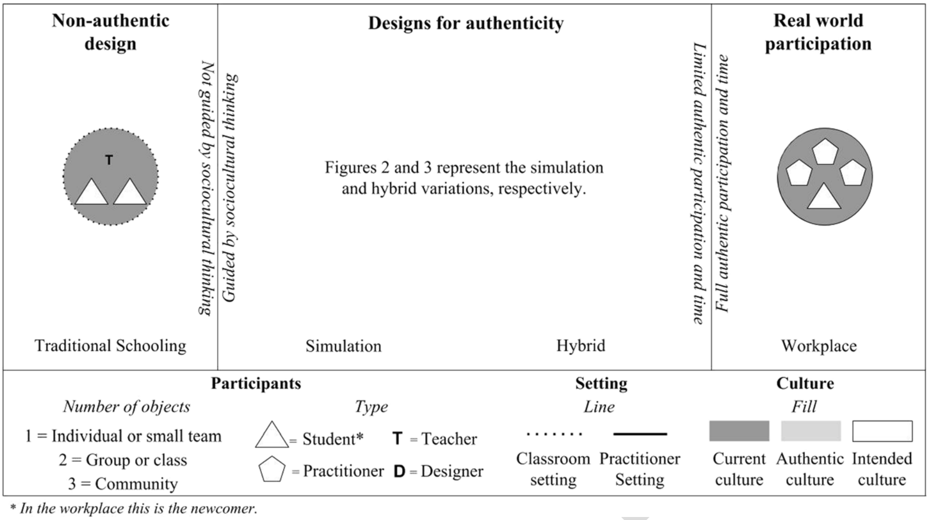

Fig. 1 Visualization of authentic designs with simulation and hybrid prototypes

language and symbolic system as non-authentic designs (traditional schooling) and real world participation (workplace) adds to the coherence of the resultant conceptualization.

Having this visual representation is not a duplicate of the different combinations of the pentad in Table 4. The visualization serves the purpose of organizing the different patterns of designs into categories with variations. This information is missed in the table, which does not show the relations between the three cultures and the facets of the pentad. The following section explicates the fine details of each case, with the differences between them represented visually (see Figs. 2 and 3, below).

Simulation approaches

Simulation approaches, represented in Fig. 2, are those where the primary effort to design for enculturation of an intended culture occurs through boundary objects and activities. While the interaction may go beyond these—whether with non-authentic or authentic outsider practitioners in different physical or virtual settings—the activities that the students engage in serve the purposes of the classroom.

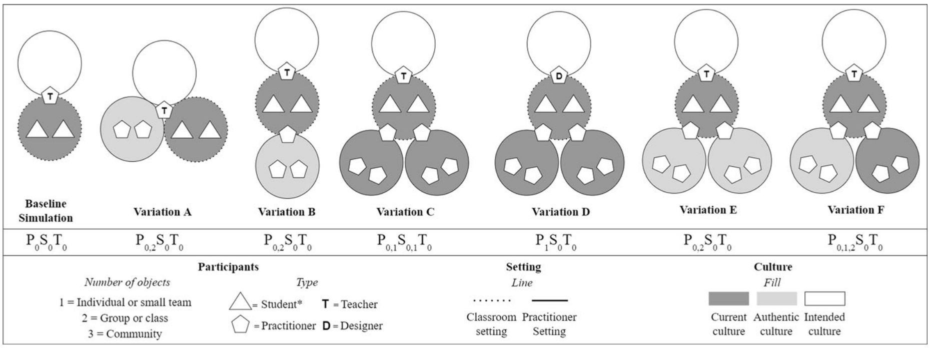

Fig. 2 Baseline simulation and variations

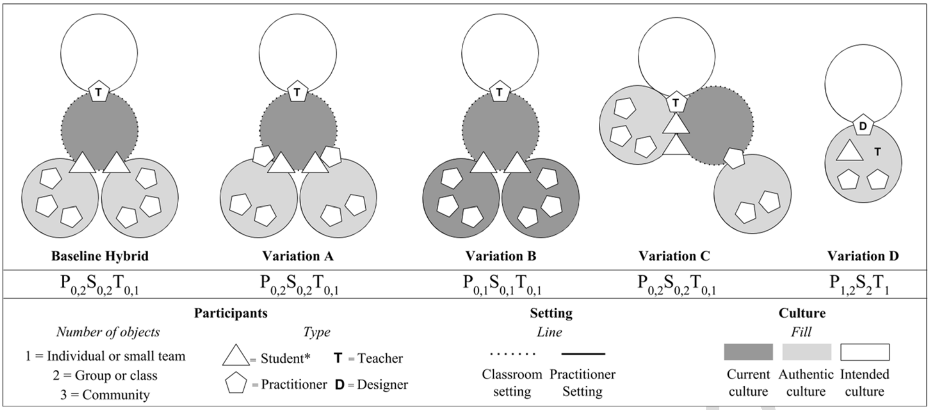

Fig. 3 Hybrid variations

Baseline simulation

The predominant design among all cases that we found are baseline simulations (Table 5). While there can be vast differences between these cases (in computer support, content area, student ages, boundary objects, etc.), all of these cases are set predominantly in a classroom, within the regular timeframe, and focused on classroom tasks that approximate those that are authentic. For example, to get students to enculturate knowledge building practices, Zhang et al. (2009) used Knowledge Forum (CS_1) and knowledge building activities to adjust the participatory structures (CL_1) within the classroom (S_0) so that the students could opportunistically collaborate with each other and the teacher (P_0) during the normal school schedule (T_0). It is not surprising that this is the most common case we found because these designs do not require (a) significant dependency on outside practitioners; (b) going outside of the educational setting; and (c) altering the typical educational timeframe.

Simulation variation A

A variation of the baseline simulation involves situations where students interact with authentic practitioners in a classroom setting within the normal school timeframe. For example, Gordin and Pea (1995) describe a design for authenticity around having students inquire about scientific visualizations (SciV). One of their projects— Undergraduate Geophysical Sciences Class at the University of Chicago—is set in the classroom (S_0) within the normal school schedule (T_0). Likewise, the participants included the teacher and students in a typical classroom ratio (P_0). In this specific case, the teacher is also a practicing scientist and therefore an expert member of the authentic culture (P_2). The collaboration was based on a cognitive apprenticeship model, where the instructor and knowledgeable peers supported students' inquiry, around computer-generated images and graphics that allow for dynamic construction of data sets (CS_1CL_1).

Simulation variation B

Magnusson et al. (1997) Dynamic Science Assessment is another example of a simulation variation. In addition to the teacher, a practitioner who was a researcher who practiced the t5.1 **Table 5** Baseline simulation cases

	Article #*	Description of Case $(P_0S_0T_0CL_1) + CS_n$
t5.3	3	The first of three projects described—ChemViz—involved high school students who studied chemistry in their classrooms by generating scientific visualizations (CS_1) through a dedicated remote connection to a tool that was used by authentic scientists.
t5.4	5	As part of school science classes in grades 6 and 7, the design of the social configurations (CS_0), physical arrangements and focal artifacts were changed to support students' enculturation of scientific discourse.
t5.5	9	Grade 7 students collaborated in pairs or small groups with a minitool (CS_1) to meaningfully analyze data through manipulation, partitioning, ordering, etc. within the context of their typical mathematics classes.
t5.6	11	Middle school students who studied in their typical science classes learned in various types of groupings and at the community level (CS_0), examining case studies as the basis of design-and-build challenges.
t5.7	12	This study focused on three different designs within three different schools with students ages 11–18. All three designs had their students engage in activities at different levels—from basic student-student dialogue to rich, bi-directional interactions among the students—around an ICT Tool (WinEcon) to mediate learning (CS_1) within typical school classrooms.
t5.8	14	Students in an advanced high school computer science course worked in pairs to solve problems using multi-layers of a computer program (CS_1), based on professional practice.
t5.9	15	Members of the class (along with four researchers), who are mainly ESL speakers, use a wiki to interact among each other mainly in small groups (CS_1).
t5.10	16	Grade 4 students, set within the classroom as part of the normal science schedule, formed small teams for opportunistic collaboration based on their emergent goals using Knowledge Forum (CS_1).
t5.11	17	Students in a college physics course studied in instructional labs and designed experiments. Students did not have direct contact with authentic practitioners, but read case studies to model how they approached problems. They used some computer-support (e.g., clickers) to scaffold their collaborative knowledge construction (CS_1).
t5.12	18	Set in four middle school classrooms, students examined problems of how ice-steam is graphed over time and argued about it in groups sized 3–6 (CS_0), appropriating argumentation discourse.
t5.13	19	Students used a scribble notes tool in a typical classroom setting to scaffold their collaborative learning (CS_1).
t5.14	20	Students in a typical classroom setting, supported by the use of Netlogo to simulate ecosystems, had to collaboratively analyze, interpret, etc. as a basis for their argumentation (CS_1).
t5.15	21	Groups in students in grade 5 and 6 classrooms participated in scientific and historical activities, such as experimentation with the support of a low tech version of the SenseMaker software argumentation tool, as a basis for their argumentation (CS_0).
t5.16	22	Students and teachers use Knowledge Forum to collaboratively build scientific knowledge at the primary level (CS_1).
t5.17	25	High school students studied information practices in a typical classroom setting and timeframe. The students collaborated around a specially designed public wiki to support their writing (CS_1).

*Refers to index of articles listed in Table 2

relevant domain culture ($P_{0,2}$) interacted with the students in a dialectical interaction through dynamic science assessment without any computer support. This, together with small group activities (CS_0CL_2), was the basis for the intended culture that tried to approximate the scientific practice of continuously advancing conceptualizations. The activities were held in the classroom (S_0) within regularly scheduled lessons (T_0). While this shares the same configuration of participants, setting, and time as Gordin and Pea's (1995) example above, it is represented differently to show that the outsiders, and not the teachers, are the authentic practitioners whom the students had interactions with.

Simulation variation C

Rosebery et al. (1992) collaborative inquiry approach is an example of another variation. The main goal of their design was for students to enculturate scientific discourse by planning and carrying out investigations in their local and home communities. As part of their investigations into the quality of water from their school fountains, students mainly collaborated among themselves and with their classroom teacher (CS_0CL_1), with occasional data gathering and sharing in their local school and community ($S_{0,1}$). In doing these investigations, students interacted with non-authentic practitioners, namely the students and teachers in the school ($P_{0,1}$). Students carried out these investigations within their regular school timeframe (T_0). Consequently, this variation is represented with a non-authentic setting in addition to the classroom.

Radinsky et al. (2001) provide another case of this variation in their 'mutual benefit partnership'. In their design, a partnership was formed between schools and a telecommunications company. While the intended learning was negotiated as part of the project, ultimately there was a "clear cultural divide" (p. 414) between what the school intended the students to enculturate—how to carry out social research using statistical surveys—and the company's goals—which were ultimately for public relations. What drove the collaboration was that both sides benefited from primary and secondary products of the students, and not that the students learned the practices of the telecommunications industry. Therefore, the company was not interpreted as an authentic culture, but the benefit to the students was a "service provided by the partner [rather] than a benefit to them [the partner]" (p. 419). As part of the design, students interacted and collaborated with students in other classes, teachers, and mentors ($P_{0,1}$). Computers supported their collaborations, particularly around computer-based presentations (CS_1CL_2). The mentors were not considered authentic practitioners because, as workers in the telecommunications company, they had very little value in the actual survey results and didn't interact with the students around the social research. The setting was a three-month summer camp, which predominantly occurred in local classrooms, but had some activities around a convention which their activities related to ($S_{0,1}$). Furthermore, the classroom group stayed together as a whole. The timeframe, although sensitive to the timing of the telecommunication company's involvement in the convention, was set dominantly within the summer camp schedule (which was designed around the project) (T_0).

Simulation variation D

Hay and Barab (2001)'s FC97 summer camp is a unique variation, similar to variation C, in that there was an inclusion of non-authentic practitioners to assist the students in reaching goals defined by the educational institution. But, there are two key differences, one of which is denoted in the code of the setting and the other in the visualization, based on the involvement of a teacher. In FC97, the context of the design was a summer camp. Specifically, three groups of students studying how to design virtual worlds worked on their projects in the morning and afternoon under the mentorship of non-authentic practitioners (CS_1CL_2)—graduate students with an education and technology focus (P_1). During lunch, they had group discussions about their projects. While there was no teacher, the designers (who coordinated the summer camp) had an intended culture in mind (of students' being virtual world designers). The meetings were set in a generic university classroom which the students never left to pursue any meaningful learning goals (S_0) and the camp lasted for one week (T_0).

Simulation variation E

O'Neill's (2001) telementoring provides a variation where high school students who studied earth science developed self-directed research projects under the guidance of a teacher. Each student or small team developed a long-term online relationship (through e-mail) with a telementor (CS_1CL_2) who was an authentic practitioner (graduate student or professionals *in the discipline*) ($P_{0,2}$). The telementors had a role of guiding and providing critical feedback to the student on their research. Although they did not formally assign a grade to the students, the telementors were coordinated through the teachers and the student-telementor interactions focused on the school activity throughout its duration (T_0). The primary setting was the classroom; the e-mail interactions provided a means for the authentic practitioners to enter (virtually) into this setting and provide guidance to the students (S_0).

Another example of this variation is Damşa (2014), who examined small group interaction in an iterative design where, ultimately, undergraduate students learned collaboratively as they solved complex problems of knowledge production with the support of file exchange and chat applications in Blackboard®. The setting was in a typical university course in a standard timeframe (S_0T_0). In addition to the ordinary participants (students and teacher), two participating clients who were authentic practitioners came in to support the students on their activities ($P_{0,2}$). They collaborated with the students both in face-to-face interaction and using the digital platform (CS_1CL_2).

Simulation variation F

Brown and Campione's (1994) well-known Community of Learners is another simulation variation. In their case, students formed a classroom community to examine themes of inquiry such as endangered species and changing populations. Expertise was distributed between the students and teacher such that the predominant interactions occurred amongst the members the community (P_0), within the classroom setting (S_0), and in an educational timeframe (T_0). Computers were not used to support the various collaborative learning modes taken up by the community (CS_0CL_1). To supplement the community members' knowledge, a cross-age tutoring system was set in place, such that students within the community could seek advice, guidance, or knowledge from members of a non-authentic culture (P_1). At times, content area experts were brought into the classroom, which they called guest teachers, to model expert practices and share their knowledge in benchmark lessons (P_2).

Hybrid approaches

Hybrid approaches, represented in Fig. 3, are those where the design is still set in an educational framework, however the learners have direct interaction with authentic practitioners on activities that serve the practitioners' interests or purposes. In addition to the baseline hybrid, we found four hybrid variations.

Baseline hybrid

The baseline hybrid includes cases where, in addition to all the characteristics of a baseline simulation ($P_0S_0T_0$) the students also have direct interactions with authentic practitioners (P_2), within their settings (S_2), and generally within their timeframes, but with some limitations imposed by the design (T_1). Fischer et al. (2007) provides an example of this. In one of two designs which they report, students from the University of Siegen balanced between "learning about" and "learning to be" as part of their practice-oriented education in information systems. Specifically, students *learned about* by participating in a University-based community system that involves academic supervisors, guest lectures, and other students in a classroom (P_0S_0); students learned *to be* by participating in local IT companies (the authentic culture) (P_2S_2). In both settings, digital medial supported the students who either collaborated among themselves or in apprenticeship relationships with the authentic practitioners (CS_1CL_2). The students' participation in the classroom has a typical timeframe (T_0); in the authentic setting the timeframe was limited to the point where the apprenticeship finished (T_1). Even though some of the internships led to further employment, the continuation of these interactions occurred outside of the design framework.

Hybrid variation A

Fischer et al. (2007) second design – University of Colorado Center for Lifelong Learning and Design Research Apprenticeship Program – is a variation on the baseline hybrid approach. In this design, each student worked in a research team that includes doctoral students, postdoctoral researchers, and faculty (P_2). This 'vertical integration' provided interactions with authentic practitioners for the graduate students in an authentic setting (S_2). At the same time, the graduate students entered into the 'horizontal integration', which was a classroom course that consisted of graduate students along with their colleagues from each research team ($P_{0,2}S_0$). Both settings were highly collaborative, both among the students and the practitioners, supported by computational media (CS_1CL_2). The goal of this design was "crossing different knowledge spaces and nourishing a fertile middle ground between disciplines" (p. 19). Therefore, the learners (graduate students) were members of both a course and authentic culture along with authentic practitioners. The students' participation in the classroom was typical (T_0); in the authentic setting the timeframe was limited to the point where the apprenticeship finished (T_1).

Hybrid variation B

This hybrid variation includes interactions that occur between multiple settings, one of which is in the classroom and another in a non-authentic environment. This is exemplified in Barab et al. (2002) community of teachers (CoT). In this case, the learners (who are teachers) formed a rich, collaborative community supported through an online forum (CS_1CL_2) and participated in teacher-guided classroom activities, such as seminars (P_0S_0). They also interacted with the staff and students in a current school where they had a chance to implement their ideas. As the purpose of the CoT was based on an intended culture of "expert teaching" (p. 491), the school was a setting that the teachers did not want to enculturate the practices of. It is therefore a non-authentic setting (P_1S_1) based on the relational definition of authenticity used in this review. Although the members of the CoT engaged in an "extended trajectory of participation" (p. 491), their participation in both aspects of the design terminated after four years ($T_{0,1}$).

Hybrid variation C

This hybrid variation, based on DiSalvo et al. (2014), comes in the context of a design that sought to take advantage of high school-aged students' interest in digital games so they can learn about computing. The design consisted of several inter-related components. Students participated in a paid work program, called Glitch Game Testers, where they had to test early versions of video games from industry clients who they had interaction with by sending and receiving reports and questions (P_2S_2). At the same time, the setting served as a classroom, where the students participated in scheduled workshops and training ($P_0S_0T_0$) with the support of technology such as the Greenfoot development environment to teach Java. The focus of activities was competitive with prizes sometimes awarded for individual achievements to motivate students (CS_1CL_0). As part of the classroom activities, they had occasional visits from authentic computer scientists (P_2). Students worked full days throughout the week during the summer, and on Saturdays during the school year (T_1).

Hybrid variation D

This hybrid variation involves designs that provide students with direct interaction with practitioners *without* an educational setting for the learners to convene as a group, such as in a classroom, but rather in an authentic environment. This variation is exemplified in Hay and Barab (2001)'s SAC97 summer camp, where "apprenticeship was operationalized as simply putting students into a real laboratory with a practicing scientist" (p. 288). Their design consisted of small groups of students collaborating among themselves and directly with a mentor scientist, with computer support such as customized web-sites (CS_1CL_2). This also included guidance from a K-12 teacher ($P_{1,2}$) on authentic research problems in the settings where the research took place (S_2). Because there was no classroom, the teachers in this case were not representatives of an intended culture, but helped students enculturate the practices of the authentic culture. While this case may seem very similar to real world participation (as illustrated in the right side of Fig. 1), this counts as a design for authenticity because there was a role of a designer (the camp director) who created this educational opportunity, a teacher who helped guide the learners, and it was limited to the duration of a summer camp (T_1).

Comparison of simulation and hybrid approaches

The visualization scheme and the codes are helpful for comparing the different analyzed cases. As we have already described, we differentiated between simulations and hybrids based on the purpose of the activities that the students engaged in. The visualizations clearly represent the distinction between the different approaches. When the triangles (students) are set within the current classroom culture when designed for authentic learning, they are simulations; when the triangles (students) touch upon a current or authentic practitioner culture outside the classroom, they are hybrids. Looking at the codes, Table 6 compiles the variations based on the pentad and between the simulation and hybrid approaches. Observations based on the summative comparisons of the approaches lead to several conclusions. The data show that with regard to participants, both approaches can include teachers, non-authentic practitioners, or authentic practitioners. Therefore, information about the participants involved in a particular design, without additional information, does not help determine which approach is taken. A look at settings is generally the same, with one exception. Within our data corpus, authentic settings only appear as part of hybrid variations. Thus, if significant activities within the design take place in an authentic setting, it is likely to be a hybrid approach. All of the hybrid cases used computer support, which was unsurprising given that technology can be used to facilitate complex collaborative configurations. Likewise, because it is hard to imagine workplaces today functioning without computer support, these are obvious cultural tools to include in authentic designs. Finally, time appears to be the clearest delimiter between approaches. Although educational timeframes (T_0) appears in both approaches, the limited authentic timeframe (T_1) appears only in the hybrid approach, and in all of its variations.

Discussion

Conceptualizations of authentic learning made in the literature, although popular, are often general in nature. The literature is fragmented in the way it explicates how or what kind of cultures are at play within designs for authentic learning. This review set out to clarify obscurities by refining conceptualizations of authentic learning through a careful mapping of the terrain. Ultimately, our review and synthesis resulted in a conceptualization of the designs for authentic learning with three distinct, but related, cultures. Likewise, we have clarified that distinguishing between simulation and hybrid approaches rests not solely on participants and settings, but based on whose goals and purposes they serve. We have instantiated our claims using a coding scheme and visual representation that was developed as part of these efforts to analyze the cases reliably and transparently. We believe this is an important contribution to the CSCL community for three reasons: First, it provides a language that allows CSCL researchers to talk more precisely about authentic learning; second, the coding scheme and visualization provide new insights about the way authentic learning environments have been designed; third, by applying the definitions and toolkit, the field finally has a map of a significant class of learning innovation that has been widely influential in CSCL. This opens up new pathways for research on a substantial area of scholarship within our field.

Reframing designs for authentic learning with the intended culture

The key idea that resulted from our review has to do with the realization that designs for authentic learning in CSCL involve three cultures, whether implicitly or explicitly stated. What we defined as the current culture and the authentic culture (Table 3) are embedded into the often referenced conceptualization by Brown et al. (1989). That is, their conceptualization is a relation between the culture of the classroom or school and the culture of the adult or professional world. The cases we reviewed, however, pointed to a third culture that is often undertheorized, but highly relevant to our expanded conceptualization of authentic learning. This is the explicit recognition (and definition) of the *intended culture.*

An undesired effect of not clearly expressing the intended culture is that people may be misled to think that the purpose of authentic designs is for the classroom to duplicate what already exists in professional or expert practice. To the contrary, in authentic designs there is a legitimate role for a teacher to be a gatekeeper of values and practices, as well as to create developmentally appropriate tasks (Edelson and Reiser 2006). It is important to recognize,

Table 6 Summative comparison of approaches

Criteria	Approach	Code = 0	Code = 1	Code = 2
Participants	Simulation	Base, A, B, C, E, F	C, D, F	A, B, E, F
	Hybrid	Base, A, B, C	B. D	Base, A, C, D
Setting	Simulation	Base, A, B, C, D, E, F	C	
	Hybrid	Base, A, B, C	B	Base, A, C, D
Time	Simulation	Base, A, B, C, D, E, F		N/A
	Hybrid	Base, A, B, C	Base, A, B, C, D	N/A
Computer Support	Simulation	Base, B, C, F	Base, A, C, D, E	N/A
	Hybrid		Base, A, B, C, D	N/A
Collaborative learning	Simulation		Base, A, C, F	B, C, D, E
	Hybrid	C		Base, A, B, D

therefore, that an intended culture based on the designer's past experiences, knowledge of learning, interpretation of authentic cultures, etc., must be a vital part of any conceptualization. To elucidate this point, we can draw on the notions of figured worlds by Holland et al. (1998). According to these authors, figured worlds are "a socially and culturally constructed realm of interpretation in which particular characters and actors are recognized, significance is assigned to certain acts, and particular outcomes are valued over others" (p. 52). Figured worlds in our context are abstracted narratives about authentic cultures that frame the activities and expectations of the classroom, produced and reproduced multi-directionally among all the actors. By being figured or imagined, the intended culture represents a combination of one or more authentic cultures that the designer(s) may be a part of. The teacher can vary between being a central member of an authentic culture or can just have knowledge of it without ever being a participating member. We are not saying that one situation is better than the other, as oftentimes practitioners are bad teachers, or the best teachers are not authentic practitioners. But, a defining characteristic of designs for authenticity is that teachers represent the culture that the designer(s) intends to foster. The intended culture is thus a conceptual bridge between current classroom culture and one or more authentic cultures. Within literature on designs for authenticity, this relationship between *what is* and *what is intended* is occasionally referred to, but not explicitly defined (see Bielaczyc et al. 2013; Hay and Barab 2001; O'Neill 2001).

This expanded conceptualization, having three cultures (current classroom, authentic, and intended) reframes Brown et al.'s (1989) conceptualization of designs for authentic learning that has two cultures (current classroom, authentic). The combination of the current classroom culture and the intended culture is a transformed culture that maintains some aspects of the classroom or school culture and some aspects of the authentic culture. In the simulated models, this aspect of the authentic culture is narrativized or figured by the teacher or designer; In the hybrid models, aspects of the authentic culture are narrativized or figured by the practicing professionals or experts in the authentic culture.

Configuring successful enculturation by designing for authentic learning

The focus of this review on the sociocultural facets—participants, setting, time, computer support, and collaborative learning (the pentad)—of designs for authentic learning led us to some interesting observations. Above all else, what comes clearly from mapping all of these cases is that there are a wide variety of possible configurations to foster successful enculturation, as the authors reported in their studies. While the goals of the different designs were too varied and nuanced to compare, each situated within their own culture and attending to different objectives, it is worth noting the wide opportunities for researchers and practitioners to think creatively about their designs.

If there is any one specific sociocultural facet that is clarified from our analysis, the value of time must be noted. Specifically, all simulation variations in this review were confined to an educational timeframe, while all of the hybrid variations had at least one component that was in the authentic timeframe (even if limited by the school setting). This finding is sensible because there is often a close relation between timeframe and purposes or interests. Activities with school goals typically take place within the parameters of the school schedule; activities with an authentic goal are situated in the timeframe of the professional setting. In turn, the goal of the activities is an important contributing factor to the cultural practices and norms that are mostly at play, whether in school or in authentic settings. Any one facet alone does not provide much information about the depth of learning and the goals of student activities. By showing that time may be an important differentiating factor between simulations and hybrids, we have new indications of the value of time in authentic learning. This is particularly important in CSCL, suggesting that designs should consider broader levels of human activity involved in the forming of collaborative relationships (Cole and Packer 2016; Rogoff and Chavajay 1995).

Practical implications

A practical benefit of this review is that CSCL researchers or designers who want to create authentic CSCL environments, or are entrenched in a particular design, can now see the big picture and generate innovative ideas. For example, the creation of an operational toolkit as part of this research provided opportunities to look at the designs of authentic learning environments in new ways. By looking across so many examples through one lens, unlikely commonalities and differences—often disguised by surface characteristics—could be identified. Simulation variation C and E both demonstrate these relationships. For example, the two cases in variation C differ wildly based on participants, time, computer support, and collaborative learning activities, but shared the same deep design approach. Understanding the underlying issues empowers CSCL researchers and designers to examine their assumptions and helps clarify the culture-laden concepts behind their designs.

Limitations and next steps

This study has limitations which open new pathways for future research. The central limitation of this study is that it has not examined the effectiveness of different design variations and the way they may have influenced students' enculturation. We therefore cannot say, nor intend to say, anything about the quality of learning within the designs. A further study looking carefully at the enculturation that resulted vis-a-vis the different designs could add new layers of understanding about how to design for authenticity, although we are skeptical of the ability to do so given the situatedness of each research setting.

Consistent with this limitation (and opportunities for future research), as an outcome of this study we cannot generalize results of authentic designs across contexts. For example, one could legitimately ask the question about how this applies to vocational education, which has embraced the idea of authenticity in recent years (De Bruijn and Leeman 2011). Vocational education provides an excellent example of how the results of this study can contribute to ongoing educational discourse, even though none of the studies that we examined were set in this context or even refer to the term 'vocational'. De Brujin and Leeman (2011) provide an in-depth discussion of the way authentic tasks within a classroom (simulation) and work placements (hybrid) have been put into these contexts. While having the language of the different cultures and the operational toolkit developed in this study could be useful in comparing the different designs they examined, our study does not contribute to an analysis of the outcomes of their interventions. We believe our research points to two ways forward. First, cases that have different variations but are set within similar contexts and with corresponding goals could be compared to help determine the effectiveness of a particular variation; second, multiple cases within a variation can be compared to better understand and elucidate the design principles underlying their successes. This is particularly important, as the field has a vested interest in impacting educational practice and must, therefore, have methods to show the outcomes of its studies (Hod et al. 2018; Wise and Schwarz 2017).

Conclusion

Beyond these conceptual and practical implications, it is important for any field to look backwards so that it can look forwards. Along these lines, recent years have ushered in a new genre of educational research taking on the idea of learning in the networked society (Kali et al. in press), such as future learning spaces (Hod 2017; Sutherland and Fischer 2014), learning environments of the future (Jacobson and Reimann 2010), and mobile learning (Sharples and Pea 2014). While it is tempting to see this new genre as a revolution and not an evolution, this determination should be guided by empirical research. Studies such as this provide a necessary foundation to examine newly emerging designs and then accurately consider what changes have been made. Given the rapid rate of societal change, there is an urgency in such reviews that map the terrain, creating stability in a changing landscape.

To conclude, this review is a long time coming given the influence of sociocultural perspectives within CSCL. The main contributions of this study are in refining conceptualizations of authenticity and developing an operational set of tools to examine CSCL designs for authentic learning. This is an important step, moving current CSCL discourse on authentic conceptualizations and designs forward, and helping the field cope with the challenges of thinking about designing learning environments in the networked society.

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