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Cross-organisational Communities of Practice: enhancing creativity and epistemic cognition in higher education

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ABSTRACT

The purpose of this work is to investigate the impact of participation in cross-organisational Communities of Practice (CoPs) on higher education learners studying Design, and specifically the ways in which CoPs can affect their creative outcomes and perceived epistemic cognition. CoPs are social groups that share common interests and goals in a particular field, and interact to build relevant knowledge and expertise. Cross-organisational CoPs can include members from diverse spheres, such as education and industry. Research on the design, implementation and evaluation of this type of CoP in HE remains limited.

Findings from this study indicate that CoPs can have significant positive effects on student knowledge gains, creative outcomes and perceptions of epistemic cognition. Key motivators triggering positive epistemic effects in learners included: authentic exchanges and interactions with members of the CoP, such as industry experts; creative constraints; prospective audiences for the end-products; and the potential impact on their future careers.

1. Introduction

This study is motivated by the reported discrepancy between what is expected of graduates now entering the creative digital industries, and the actual skills they hold (Edmondson, Valigra, Kenward, Hudson, & Belfield, 2012; Leung & Bentley, 2017). The modern creative and knowledge economies have transformed employment prospects most significantly in that basic labour competencies have been replaced by expectations of higher-order thinking skills (Leung & Bentley, 2017; Mourshed, Patel, & Suder, 2014). New graduates must think innovatively and also be able to transfer and apply knowledge to come up with creative solutions that are suited for real-world contexts (Mourshed, Farrell, & Barton, 2013).

That said, although crucial, creativity is often overlooked in higher education (HE), usually because it is perceived as too difficult to cultivate or complex to measure (Allee, 2000; Hildreth & Kimble, 2004; Lee, 2014). Creativity is a construct synonymous with the development of appropriate outcomes in response to real-world problems or goals, a fact that makes *authenticity* an important constituent of creativity in education (Amabile, 1982; Furnham, Batey, Booth, Patel, & Lozinskaya, 2011; Kaufman & Baer, 2005; Runco & Jaeger, 2012). Apart from its real-world relevance, authenticity in learning is also linked with ill-defined problems, collaboration with professionals, external (integrated) assessment using industry resources and criteria, and the development of useful and polished products (Brown, Collins, & Duguid, 1989; Herrington, Reeves, & Oliver, 2014; Lombardi, 2007). Blending *creativity* and *authenticity* in education can thus produce the kind of graduates with both creative capabilities and sound vocational experiences who are in current demand to implement "economic and innovation growth" on a global level (Albats, 2018; Perkmann et al., 2013). HE programmes can be modernised through robust industry alliances, which can in turn support the development of diverse creative skills and processes; these are currently missing from today's industry which are nonetheless required to achieve innovative outcomes (Edmondson et al., 2012; Mead, 2015; Roodhouse, 2009).

The present investigation assumes that creativity and authenticity in education can effectively meet within a situated learning framework - particularly through Communities of Practice (CoPs) (Wenger, 1998). CoPs are groups of people driven by a common passion, interest and goals in a specific area, who connect to co-create knowledge and competence through interaction and collaboration (Lave & Wenger, 1999). We posit that by bringing together CoP members from the academia and industry (i.e. a cross-organisational CoP), the knowledge and skills needed to develop enhanced creative outcomes that are well

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suited for the real world will be effectively fostered (Albats, 2018; Ivascu, Cirjaliu, & Draghici, 2016; Jackson, 2016). To date, research reporting on the role of this type of CoP in education has been limited. In particular, work looking into the design of cross-organisational CoPs, their social structure and dynamics (Perkmann et al., 2013), as well as their epistemic impact is missing. Authors (Amin & Roberts, 2008; A. DeChambeau, 2017; Smith, Hayes, & Shea, 2017) have argued for deeper investigations of CoPs' epistemic potential, and particularly, for research which is hinged on specific disciplines. Within the scope of this work, we borrow from the framework of *epistemic cognition* and use its variables to enrich the meaning of the term '*epistemic*' to reflect not only on the tasks associated with learning (Carvalho & Goodyear, 2014), but also on how learning is co-created or negotiated between CoP members, why it holds value to them and how it can be transferred (Greene & Yu, 2016; Sandoval, Greene, & Bråten, 2016). These variables directly guide the research questions of this study that focuses on the Design domain and related fields (i.e. Technology, Human Computer Interaction (HCI) and Engineering).

The overall purpose of this work is to investigate the impact of participation in a Community of Practice (CoP), specifically around the epistemic knowledge and creative outcomes of higher education learners studying Design. The study examines a group of university students and ten mentors from industry who take part in a cross-organisational CoP to share knowledge and competence in the field of Design. It specifically aims to measure the CoP's impact by comparing two groups (an experimental and a control group), in addressing the following research questions (RQs):

RQ1. : What are the differences in the creative outcomes of learners who participated in the CoP versus those who didn't, as evaluated by external CoP stakeholders?

RQ2. : What are the differences in the conceptual knowledge gains for the learners who participated in the CoP versus those who didn't, based on the final exam scores?

RQ3. : What are the differences in the levels of communication between learners across the two groups?

RQ4. : What are the CoP (experimental) group learners' perceptions of their *epistemic cognition?*

In the following sections, we provide evidence of relevant work in the area, outline the research and learning design, describe the data collection and analysis methods and report on both quantitative and qualitative outcomes. Finally, the findings are interpreted, compared and linked to existing literature in the discussion section.

2. Theoretical background and related research

2.1. Creativity

Conducting research on creativity is challenging due to its multi-dimensional nature (Cherry & Latulipe, 2014; Furnham et al., 2011; Shneiderman, 2007). Related investigations looked into the individual characteristics (personality, traits, inclinations), collective or social creativity (distributed), the creative processes, the affordances of environments that nurture or hinder creativity, or the creative outcomes as a result of the above (Allee, 2000; Amabile & Pillemer, 2012; Hildreth & Kimble, 2004; Horn & Salvendy, 2006).

With regard to education, what we currently know is that students attending rigidly designed programmes, isolated from their professional counterparts exhibit a considerable lack of creativity (De Graaf & Kolmos, 2003; Renkl, 2001). Instructional practices in de-contextualised learning settings, driven by artificial projects and objectives, are evidently not geared to support learners toward creative performances (Brown et al., 1989; Herrington et al., 2014; McCrigler & Rippens, 2016).

University-industry collaborations (UIC), could thus be used to explore the bridge between the two and discover how the constraints of the real-world can affect creativity in learning (McCrigler & Rippens, 2016). Constraints can have an interesting impact on creativity, with some studies presenting them as inhibiting (Rosso, 2014), and others, as empowering depending on the context (Onarheim, 2012; Takala, 1993). Unrestricted projects tend to lead to easily discovered and 'comfortably' developed solutions that do not constitute true creative breakthroughs (Stokes, 2005). On the other hand, realistic constraints can urge people to find different ways to rectify problems, specifically, by employing advanced creative thinking processes (Fisher, 2011; Gilson & Shalley, 2004; Nagarkatte & Oley, 2017). It is thus valuable to examine how constraints imposed by real-life practices can affect learners, especially in inherently creative fields such as Design.

2.2. Communities of practice

The CoP framework (Wenger, 1998) draws on situated learning (SL) theory, which denotes that true learning cannot occur outside of the context in which it is meant to be transferred and applied (Brown et al., 1989; Lave & Wenger, 1991). A CoP can be instigated by any social group that shares common interests, understanding, beliefs and goals in a particular field (Vaughan & Dornan, 2014). In such cases, learning happens automatically through co-creation or negotiation of meaning and knowledge amongst its members (Wenger, 2010a). The concept of Legitimate Peripheral Participation (LPP) indicates that members (i.e. novices, intermediaries) can keep their participation in the community to a minimum if they so wish, with the option to gradually deepen their involvement as they gain competence by imitating more experienced others in the community (Wenger, McDermott, & Snyder, 2002).

Effective CoPs commonly offer three levels of participation (Wenger, 2001). These include: a) the core group, typically the leadership of the CoP, which includes members who vigorously engage and make contributions, partake in projects, and steer the community, b) the active group, which operates at the level following the first group and includes members who are active in the community through public discussions or meetings, but remain outside of the core group, and last c) the peripheral group, which comprises members who seldom interact with or contribute to the community; yet, as observers, they might engage in private discussions, absorb information, "gain their own insights" (Wenger, 2001) and apply them in their own time. A recent, more flexible version of the participation model (Fig. 1) adds two more levels, namely the occasional and the transactional (which may or may not occur) (Wenger-Trayner, 2011). In this study, we have adopted and reconfigured this model to reflect the synthesis of a cross-organisational CoP as utilised in the context of a formal Design curriculum.

Wenger, White, and Smith (2009) also suggest that communities may benefit from *multimembership*, that is, through the participation of members that belong to other communities, who come together to form broader "constellations and networks". The CoP in this study adopts this concept of *multimembership* with its cross-organisational nature - students, mentors, experts and educators - belonging to diverse communities and transferring their knowledge across boundaries within the Design domain.

2.3. Empirical applications of CoPs in formal learning contexts

Various studies have adopted CoPs to improve and strengthen the practices of social groups in the education (A. DeChambeau, 2017; Tight, 2015), industrial (Ardichvili, Page, & Wentling, 2003; Pattinson & Preece, 2014) and public sectors (Bate & Robert, 2002; Tangaraja, Mohd Rasdi, Ismail, & Abu Samah, 2015). The benefits of CoPs have been widely attributed to their "socially mediated learning" processes (Gunawardena et al., 2009) which are known to foster personal development through LPP (Stone et al., 2017; Woo, 2015), knowledge networking (Allee, 2000; Hildreth & Kimble, 2004), enhanced reflection

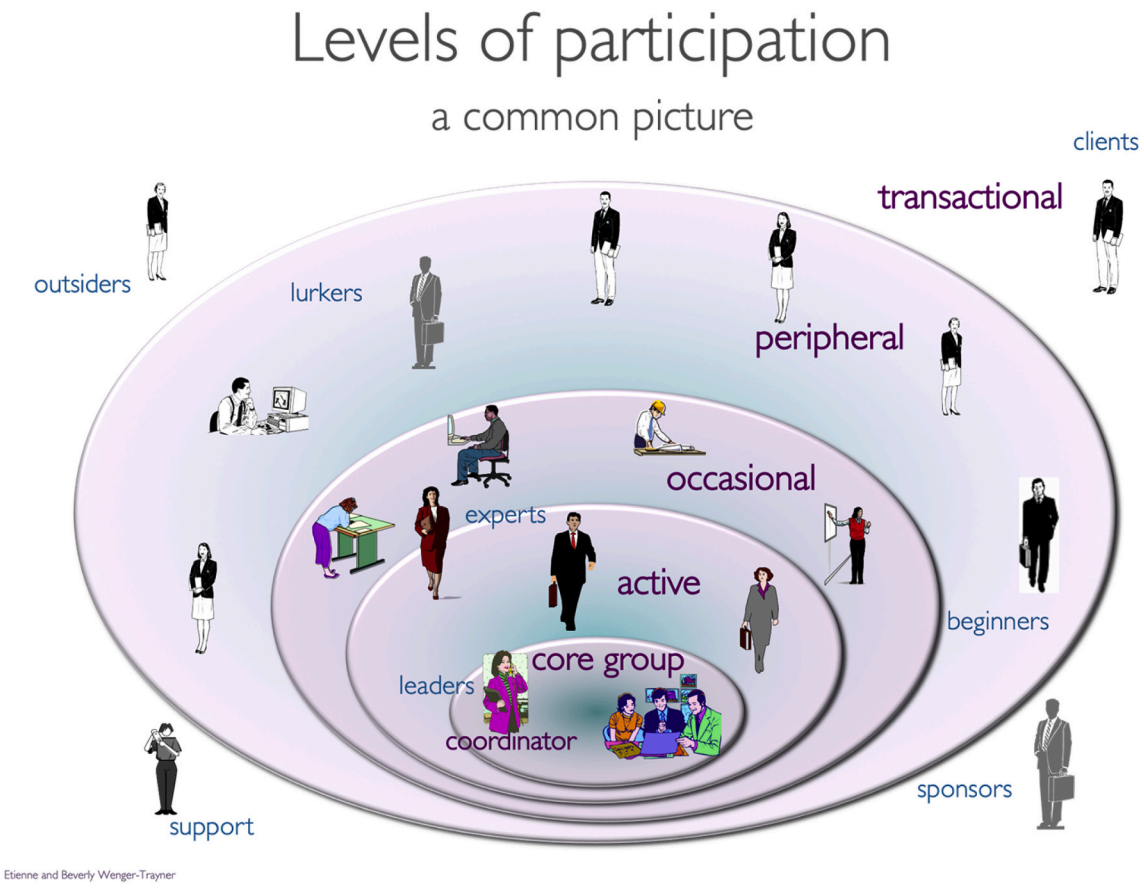

Fig. 1. Model of Levels of Participation (Wenger-Trayner, 2011)

(Rourke & Coleman, 2009), innovation (Goodyear & Casey, 2015) and professional growth (Khalid & Strange, 2016; Tseng & Kuo, 2014).

While widespread in all education, the adoption of CoPs has been particularly prevalent in HE, which involves more autonomous learning minimizing the need for instructor reviewing and guidance (Johnston, 2016; Wisker, Robinson, & Shacham, 2007). An effective study focusing on a CoP of doctoral students in education studies demonstrated the positive role of CoPs in minimizing isolation, reaching work-life-education balance, and achieving positive and successful scholarships (Aimee DeChambeau, 2014). The work also presented qualitative indicators of academic success, in the form of increased scholarly abilities, higher levels of personal accomplishment and growth, positive identity transformations, and lifelong learning skills. Likewise, additional work highlighted CoPs' capacity to provide the grounds for *meaningful formative assessment*, as this enveloped in a doctoral students' discussion forum. The researchers argued that the student-supervisor, and importantly, the student-student review processes in the peer subgroups that had developed, helped "illuminate assessment as a social practice" (Crossouard & Pryor, 2008).

Indeed assessment and feedback present themselves as two powerful benefits of CoPs, especially when they are enriched with diverse knowledge and feedback from external (i.e. industry) sources. One example of this, was a study by Squire and Johnson (2000) on distributed CoPs which comprised teams of secondary education students, experts from the industry, and various faculty members, to facilitate their (design) project development processes. CoP members connected systematically via an LMS and an interactive television (ITV) system to collaborate and exchange feedback on the work in real-time. Findings indicated that a) student-student evaluations encouraged 'rigorous commentary' and effective critical analysis through feedback, and b) student-expert interactions generated higher levels of motivation and eagerness to participate in the practice, not merely for project development purposes, but for the opportunity to discuss Design practice and build social relationships with specialists in their field.

Focusing on such *cross-organizational* (student/expert) approaches, Jackson (2016) later on drew upon the CoP framework to theoretically frame the conceptualization of how HE students' pre-professional and professional identities can be developed; by proposing the merging of academic and external bodies (i.e. career services and industry practitioners) in CoPs, and deriving respective design implications for learning.

While, Jackson's (2016) work provides solid theoretical grounds and motivation for the application of cross-organizational CoPs in HE, there is still limited empirical evidence of such initiatives in literature. We conclude that there is dearth of research in terms of the:

a) Cross-organisational perspective: investigations of the design, enactment, and impact of cross-organisational CoPs on the learners' epistemic knowledge and skills, as prospective practitioners, are scarce. The skills gap between education and industry is significant and while many HE institutions have moved toward industry-academia partnerships to mitigate this gap, the dynamics and outcomes of such collaborations, analysed through the lens of a robust social learning theory like CoPs, still remain largely underexplored in literature (Albats, 2018; Ivascu et al., 2016; Spagnoletti, Resca, & Lee, 2015; Turbot, 2015).

a) Localised epistemic perspective: as CoPs stem from SL theory, relevant research needs to take a localised approach, driven by the distinct characteristics of the domain it evolves in (Smith et al., 2017). Studies looking into the design, enactment and impact of CoPs in the practices, social structures and culture of specific disciplines still remain scant in the literature (Amin & Roberts, 2008). This clearly calls for more targeted research that aims to report on the cross-organizational CoP model, as this is designed and enacted within the context of a

particular discipline, such as the Design discipline, in this case.

2.4. Epistemic cognition

The present study focuses on the effects of a CoP on student epistemic outcomes. In doing so, it draws from related literature to understand the *epistemic* component (Murphy, Alexander, Greene, & Edwards, 2007; Sandoval et al., 2016). Murphy et al. (2007) offered the term *epistemological beliefs*, also known as *personal epistemology*, which is the examination of people's beliefs about their own "knowledge and knowing" (Hofer, 2001), and the enhancement of those beliefs with a research-oriented dimension (epistemology) (Greene & Yu, 2016; Murphy, Alexander, Greene, & Hennessey, 2012). The concept was later broadened and termed *epistemic beliefs*, which covered both a) researcher beliefs, which focus on the study of knowledge and knowing and b) student beliefs, which focus on their own knowledge and knowing itself. Still, the construct lacked a study of the procedural aspect through which *knowledge* and *knowing* can result. The need for enhanced inclusiveness led to *epistemic cognition*. The term refers to learner knowledge itself, the justification of why it constitutes knowledge, how it was created or negotiated amongst collaborators, and the ways in which it is or can be used (Greene & Yu, 2016; Sandoval et al., 2016). Cognitive activity, as part of learning, occurs in everyday life and is highly situated; it takes into account the affordances of the context in which it occurs, and how specific problems can be addressed by using these affordances (Brown et al., 1989). Hence, the process of gaining knowledge is embedded within its context - be it the tools that are used, the people or the interactions involved. In this work we investigate and report on the variables of *epistemic cognition* that were adopted to reflect the situated learning approach.

3. Materials and methods

3.1. Research design

This study follows a mixed-method design approach, in which both quantitative and qualitative data were collected (Creswell, & Clark, V. L. P., 2011). In the first phase, we adopted a two-group quasi-experimental design for investigating the effects of the cross-organisational CoP on students' creative outcomes and knowledge gains. Next, we collected qualitative data to deepen our understanding of students/CoP participants' pistemic cognition as a result of their participation in the CoP.

3.2. Participants

Thirty-eight 3rd-year undergraduate students (26 female and 12 male) participated in the study. The students (aged 21-24, M = 22.4) were enrolled in a Web Design and Development (WDD) course, attending 180-minute weekly classes over the course of 13 weeks). They were divided into two cohorts. Cohort 1 (N = 21) served as the experimental group and Cohort 2 ($N = 17$), as the control group.

The students possessed the same background knowledge, having followed the same syllabus in previous academic years. Their GPAs were almost identical (Table 1).

3.3. Procedure

3.3.1. Learning setting

Students in both groups self-formed their teams (of approximately four students each). Each group was assigned a real-life project for the semester. A total of five industrial stakeholders (clients) delivered project briefs to the students for the design and development of websites tailored to their specific business needs (Table 2) . Each project was developed twice, once by a team in the experimental group and once by a (shadow) team in the control group, resulting in a total of nine projects (note that the control group included only four teams). The groups shared course material and used the same instructional approach. They differed in that only the experimental group students participated in the cross-organisational CoP that was strategically supported by technologies both in and out of the classroom. The CoP (along with its technology setup) was therefore only applicable to the experimental condition students. A detailed description of both groups and conditions is presented in the following sections.

The weekly sessions employed a problem-based-learning (PBL) approach. Students were given ill-structured, 'messy' problems, as tasks that required hands-on solutions. These in-class tasks were timed to align with the development phases of their project cycle. Students were prompted to first conduct individual research and then team up to discuss findings, determine specific requirements and define the appropriate course of action. Teams were randomly asked to present and explain their research outcomes to the class, inviting peer feedback. Mini-lectures, resources, and brief workshops were provided by the instructor or the floating facilitator (outlined in the experimental condition below), whenever necessary (authors' reference). The teams then proceeded to experiment and develop solutions using online synchronous collaboration tools (experimental group only) and offline software. They were typically subdivided into pairs sharing a computer in class. Upon task completion, the teams concluded with short demonstrations, which were followed up with a Q&A and discussion with peers.

3.3.2. The experimental condition social infrastructure

The cross-organisational CoP included the following members: a) the instructor of the module b) a floating facilitator: a graduate student recruited as a teaching assistant mostly for in-class processes, c) alumni mentors: three alumni with a minimum of three years of industry experience, offering feedback and steering discussion on project deliverables, d) industrial mentors (clients): five local organisations/agencies, assigning projects, delivering content and feedback and participating in meetings throughout the semester (see Table 2) and finally, e) industrial experts: three experts with (a minimum of six years) industry experience, who were responsible for the evaluation of the completed projects (Fig. 2). By design, the CoP members were motivated by the following factors:

Facilitators. As graduate students in the same department, they could support the learning process both in class and online. Voluntary participation can often be found amongst students with a sound interest in advancing their knowledge and expertise in an area, especially in light of their forthcoming entry into industry.

Alumni mentors. As graduates of the department with an intrinsic interest in the Design field and driven by ethical motives, they often show willingness to give back to the university by helping others on similar trajectories (Wenger, 2010b). They typically wish to maintain good social ties with their departments/schools, in light of their

Table 1
Comparison of experimental and control group GPAs

	Group	N	M	SD	F	Sig.	t	df	p
GPA	Experimental	21	7.279	0.912	1.892	.178	-.074	36	0.941
	Control	16*	7.260	0.565					

* Unavailable grade information for one participant

Table 2
Experimental and control group team structure & CoP industrial membership

Project / client domain	Law Consultancy	Non-profit	Sports Management	Property Development	Investment Services
Team	A	B	C	D	E
Experimental (CoP)	4 female	1 female 3 male	4 female	2 female 3 male	3 female 1 male
Control	4 female	5 female	5 male	3 female	-
Alumni mentors		2 female, 1 male			
Industrial experts		3 male			
Industrial mentors (clients)		2 female, 3 male			

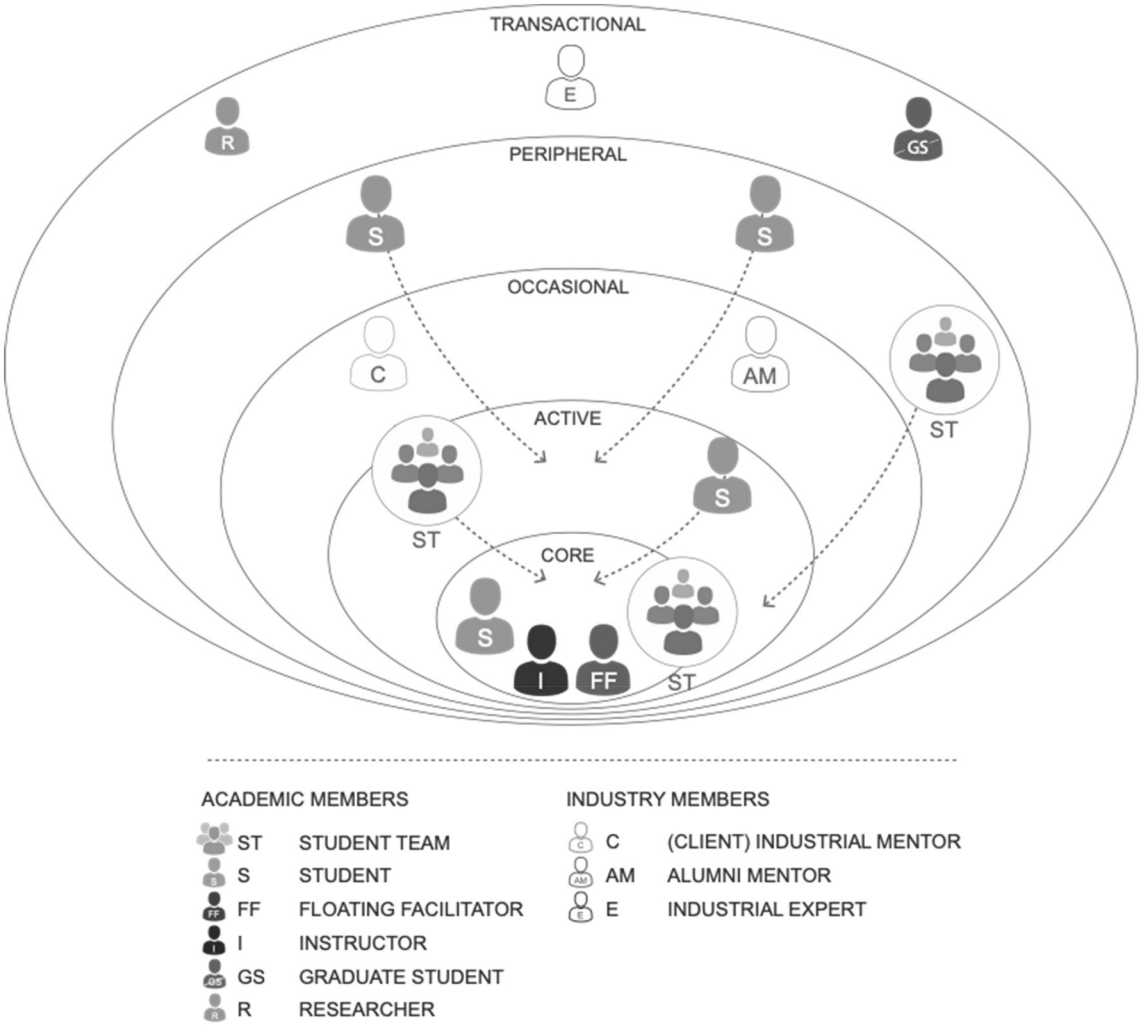

Fig. 2. Cross-organisational CoP 'Levels of Participation' Model

relatively recent academic history. Such "expressions of loyalty" (McAlexander & Koenig, 2001) are representative of alumni with positive academic experiences (Pearson, 1999). Their involvement may also be considered an advantage on their early-career resumes.

Industrial experts. As professionals in the field, they are motivated by the chance to have a say in education and to establish an open channel of communication with the faculty. Additionally, their involvement in student projects can serve as an opportunity to draw from a filtered talent pool for future recruitment purposes.

Industrial mentors (clients). Local businesses/organisations are usually keen to receive free support in developing early ideas, prototypes and 'proofs-of-concept' for pending projects. The help may be valued due to a focus on other priorities, a lack of resources (budget, time and human capital) or a heavy workload.

Drawing from the 'levels of participation' model (Fig. 1), Fig. 2 indicates the position of the cross-organisational CoP members and their respective levels of participation (depicted in circles), and Table 3 presents the rationale behind each decision. While the cross-organisational model was designed based on the idea that different CoP roles would enter specific circles of participation (i.e. active, occasional peripheral) depending on their *interests*, *input* and *availability* (i.e. external members), it was also anticipated that the boundaries of these circles would be fluid. In fact, the CoP theory foresees this, since as the topics of interest and attention, and the meaning-negotiation processes in the community can shift over time, members enter and exit its various 'circles' accordingly (Boylan, 2010; Farnsworth, Kleanthous, & Wenger-

Table 3
Cross-organisational CoP members, levels of participation, and decision rationale

	Members	Levels of participation	References from CoP theory supporting the rationale of member participation levels*
1	Instructor/ coordinator Floating Facilitator Student Teams or Students	Core group	CoP leadership, active engagement in discussions, community steering, projects involvement. Members become auxiliaries to the CoP coordinator over time Community portion: 10-15%
2	Student Teams Students	Active group	Meetings attendance, occasional participation in CoP forum (i.e. social network), without the regularity and intensity of the core group Community portion: 15-20%
3	Alumni Mentors Clients	Occasional group	Participation only based on a topic of interest, some contributive action to the community, or project involvement
4	Student Teams Students	Peripheral group	Sustained connection to the community, but less engagement and authority. Observations of core and active members' interactions help gain own insights. Semi-private, one-to-one interactions keep the peripheral members connected. Community portion: large
5	Industrial Experts Graduate Students Researchers	Transactional group	Outsiders' (non-members) occasional interaction with the community, to receive or provide a service or gain access to community artifacts (i.e. publications, website, tools, resources)

* Sources: (Farnsworth et al., 2016; Wenger et al., 2002; Wenger-Trayner, 2011)

Trayner, 2016). This engagement/disengagement pattern indicates a healthy type of movement and supports a feeling of legitimacy, regardless of the participation level in the CoP.

3.3.3. Experimental condition technology configuration

As industrial members could not be physically co-located with others, the CoP design was supported and enabled by technology. The five student teams (community subgroups) were asked to use tools such as Conceptboard - a real-time distributed virtual canvas - mostly for early-stage brainstorming, card-sorting, research, resource collection, experimentation and artefact creation, and Google Drive, Documents and Sheets, for shared document management (creation, co-editing, storage) purposes. The student teams could also invite other CoP members to view project deliverables as they were being developed. Following an instructor's suggestion, Google Hangouts was used as a synchronous communication tool. Community-wide (student teams and industry members) programmes included Adobe's Behance (an online portfolio/professional networking tool) and Hypothes.is (a browser-based annotation tool). The latter two provided public viewing and commenting (feedback) on visual artefacts (i.e. sitemaps, interface prototypes, web pages). An in-depth analysis of the CoP's technology setup is reported in a parallel study (author reference).

3.3.4. Delineating the cross-organisational CoP from other social groups

It is important to caution against misjudging any social configuration (i.e. friends, class, operational team) for a CoP, as this would make the concept meaningless (Wenger, 1998).

A CoP presupposes the existence of a *domain* (of knowledge), a *community*, and a *practice*. It reflects a "social process of negotiating competence in a domain over time" (Farnsworth et al., 2016). In this work we provide evidence of the participants' goals and efforts, located within the Design domain, as members of a community in which they socially connected, interacted, generated relationships (and prospects of future connections), negotiated knowledge and competence, co-used tools and resources, and co-developed artifacts over time through their *practice* in the *domain*; that is – primarily – the "practice of being students" (A. DeChambeau, 2017), the practice of *becoming* (and being assisted to become) prospective practitioners, and the practice of (external members) contributing to and shaping the Design workforce and the Design scene.

Although sharing overlap with other social groups, such as 'communities of interest' (CoIs), 'project teams' and 'informal networks', the CoP in this study exhibits distinct characteristics that help determine its nature. In brief, it comprised a homogenous group of members who originated from the same *discipline* and subscribed to a common knowledge domain (Design), as opposed to the *multi-disciplinary* orientation of CoIs (Fischer & Bell, 2004). Thus, with the exception of 'industrial mentors' (as 'clients' who are otherwise provisioned by the original model in Fig. 1), the heterogeneity of memberships in this CoP stems from an organisational (academic/industrial) rather than a disciplinary (domain) context. That said, CoP theory does in fact, allow room for disciplinary heterogeneity, in the cases when the help of 'intellectual neighbours' is required (i.e. solving interdisciplinary problems) (Wenger et al., 2002). Further, this CoP is unlike a group of 'project teams', who are strictly driven by well-defined assignments and measurement criteria to form 'task-driven partnerships' (Farnsworth et al., 2016). Instead, participants in this study were members of an organic community (initiated by students in their early academic career) which developed through sustained risk-free expression, experimentation, social relationships and – importantly - a shared identity. This community was later on enriched with external memberships (mentorships). As such, the CoP presented in this work also deviates from the concept of an 'informal network', as it was largely driven by collective (CoP identifying) – rather than individualistic – intentions (Probst & Borzillo, 2008).

3.3.5. The control condition

The control group followed the same course syllabus, structure and PBL approach, but was facilitated solely by an instructor. There was no interaction with CoP members (facilitators, alumni mentors, industrial mentors or industrial experts), hence CoP-supporting technology was not utilised by this group. Choice and degree of technology adoption was left at the teams' discretion.

3.4. Data collection and analysis

3.4.1. Evaluation of creative outcomes using the Web Site Creativity Measurement Instrument (WSCMI)

The instrument was developed by Zeng, Salvendy, and Zhang (2009) for the evaluation of website creativity by examining seven factors (28 items) (Table 4). Based on a blend of theoretical underpinnings, these items assess: *Aesthetic Appeal, Interactivity, Novelty & Flexibility, Affect, Importance, Commonality & Simplicity,* and *Personalisation*. Below, we lay out the definitions of these terms as specified by the WSCMI authors.

Aesthetics, a concept intertwined with creativity, is the largest factor (10 items) on the scale (Amabile, 1982; Charyton & Merrill, 2009; Demirkan & Afacan, 2012). *Affect, Novelty* and *Importance* are factors originating from traditional hardware creativity evaluation, namely the Product Creativity Measurement Instrument, developed by Horn and Salvendy (2009). *Novelty* and *Importance*, represent the two major subconstructs prevalent in the majority of theories on creativity. *Affect* is also considered a strong antecedent of creativity in both the cognitive and practical dimensions of learning (Alfonso-Benlliure & Santos, 2016; Amabile, Barsade, Mueller, & Staw, 2005; Barczak, Lassk, & Mulki, 2010). *Flexibility*, a constituent of the *Novelty* factor, features distinctively in web products (i.e. websites and apps), specifically in the extent to which content, design and functionality can flexibly accept updates that improve the product's creative value. *Interactivity* and

Table 4
Web Site Creativity Measurement Instrument (WSCMI)

Aesthetically appealing design	Artistic
	Colourful
	Energetic
	Beautiful
	Fascinating
	Entertaining
	Engaging
	Attractive
	Favourable
	Desirable
Interactive design	Interactive
	Animated
	Multimedia-available
	Dynamic
Novel and flexible design	Original
	Appealing
	Flexible
Affective design	Stimulating
	Pleasing
	Delighting
	Exciting
Important design	Relevant
	Important
	Crucial
Common and simple design	Infrequent
	Rare
	Sophisticated
Personalised design	Personalised

Personalisation derive from the same area. *Interactivity* denotes the level, meaning and efficiency of the dialogic process between the user and a system, or the responsiveness with which a system reacts to user actions. This plays a vital role in the user's holistic perception of the system (Kuan, Bock, & Vathanophas, 2005; Zeng et al., 2009). Likewise, the customisation (*Personalisation*) of the interface and content, based on user settings and preferences, can upgrade the perceived creative worth of a website. Last, *Commonality* and *Simplicity* refer to the way that rare or sophisticated websites can, with a moderate amount of complexity, generate engaging but not overwhelming user experiences.

The core evaluation group using the WSCMI to rate the websites of both experimental and control groups included all industrial members (N = 10 (one industrial mentor evaluation missing)) of the CoP (alumni mentors, industrial mentors and experts). To confirm and validate the effects of the intervention from varied perspectives, the websites were further assessed by the department's graduate students (N = 24) and HCI researchers (*N* = 4). A total of 38 evaluators (16 male and 22 female) completed the questionnaire using a 7-point Likert scale, with responses ranging from "Strongly disagree" to "Strongly agree", resulting in a total of 317 valid responses.

3.4.2. Conceptual knowledge assessment

A final exam was administered to students in both control and experimental groups at week 15, two weeks following the conclusion of the semester. The exams consisted of 16 questions in total: 12 multiple-choice and 4 open-ended, all probing for theoretical and practical (coding) knowledge and critical decision-making (Table 5).The exam papers were marked by the course instructor.

3.4.3. Focus group interviews and field notes

The focus group interviews used a 'purposive sampling' technique, which summoned the experimental group team members as the participants, based on their shared experiences related to CoP-based participation and learning (Longhurst, 2003). Such pre-existing social groups are ideal for communicating the social context in which ideas and decisions are formed, and distinguishing between individual beliefs and the actual behaviours and events that transpired (Bloor, 2001).

A researcher conducted three semi-structured focus group interviews with project teams (5 teams x 3 sessions) during or following classes between semester-weeks 4 and 13. Each session lasted approximately 35 minutes, resulting in a total of 7.5 hours of recorded sessions. Based on their shared acquaintance and knowledge, students were initially asked to talk freely about their roles and collaboration processes in the team (e.g. How did you share the work responsibilities? Did you work concurrently or consecutively? How well did you collaborate with the external members of the community?) and then to openly discuss the factors that contributed - positively or negatively - to their knowledge gains, creative processes and respective outcomes, (e.g. To what extent did interaction with and feedback from the community affect your creative processes and outcomes – both as individuals and as a team? Are there any differences between this and other projects you have worked on as part of your course?). Students were also asked about resolving issues that had come up during their CoP sessions (e.g. What were the major issues that came up while working with real clients, and being guided by mentors? How did you handle them? How did they affect your creativity, your collaborations and generally what was their impact on you as students/designers?).

The instructor field notes comprised observational remarks that were categorized by week (totalling 2,396 words). The recorded topics concerned insights on class-based work processes, creative moments and epistemic breakthroughs in within-team and CoP-wide interactions, team coordination, responsibilities and procedures, motivational factors (interest, engagement), and affective issues relating to time pressures, trust, and team confidence.

3.4.4. Data analysis

The creative outcomes evaluation scores (WSCMI), and the conceptual knowledge gains (final exam scores) for both participant groups were formatted and imported into SPSS for statistical processing.

Table 5
Examples of three types of questions to assess conceptual knowledge

Short-answer questions	
Which graphics file type would you choose, if you had to optimise a full-colour image with multiple gradients, to achieve a lossless image compression for the web and why?	
Please explain the two main advantages of using a <label> tag rather than plain text in HTML forms.	
Multiple-choice questions	

Please select two of the following options, which reflect correct syntax for the label tag in an HTML form:	`<label id='student'> long description </label>`
	`<textarea id='student'> text </textarea>`
	`<label> long description <textarea id='student'> text </textarea>`
	`</label>`
	`<label> long description </label>`
	`<textarea id='student'> text </textarea>`
	`<label for='student'> long description </label>`
	`<textarea id='student'> text </textarea>`

Long-answer - essay type questions	
Explain the concepts of a) 'grid-based' and b) 'above the fold' design.	
Discuss how these translate to design heuristics for the web.	

Primarily, we screened the data for outliers. In the case of the exam scores, this process identified one out-of-range case as an extremely low value (outlier) and was therefore excluded from the sample. Based on the sample size in this case, we further explored the exam scores data to test the normality assumption through a Shapiro-Wilk test, which generated a non-significant result ($W(37) = 0.96$, $p = 0.36$), confirming that the data was normally distributed (Shapiro & Wilk, 1965).

In the case of the WSCMI scores, based on the fact that large samples can be valid for any distribution (Ghasemi & Zahediasl, 2012; Lumley, Diehr, Emerson, & Chen, 2002), we proceeded to investigate the instruments' factor reliability (internal consistency) and concluded optimal levels of internal consistency at $\alpha > 0.9$ for all factors (excluding single-item factor 7) (Cronbach, 1951).

In terms of communication frequencies, we recorded the CoP/non-CoP emails (experimental, control conditions) and feedback exchanges in Behance (experimental condition) for further comparisons.

The qualitative data from focus group interviews and instructor field notes were formatted and imported into NVivo for thematic analysis. A subset (20%) of the lengthy dataset, totalling 14,357 words, was selected based on subject relevance, and analysed inductively using an open coding method (Patton, 1990). To derive semantically inclusive inferences with respect to the research aims, we defined text segments of multiple (versus single) sentences as the unit of analysis. We investigated participant and instructor perceptions of concepts relating to *epistemic cognition* and *creativity* in conjunction with CoP participation. Specifically, the derived codes reflected such CoP experiences which triggered epistemic and creative reactions in the learners' processes and outcomes. These are presented in Table 9.

4. Results

4.1. Evaluation of creative outcomes (RQ1)

An independent samples t-test was conducted for each of the seven WSCMI creativity factors to examine mean differences between the control and experimental groups. Following Bonferroni correction for Type 1 error (alpha level set to .05/7 = .007), statistical differences emerged between the groups across the seven factors, all in favour of the experimental group. The websites developed by the teams in the experimental group received, on average ($M = 4.17$, $SD = 1.34$), significantly higher scores than those in the control group ($M = 3.23$, $SD = 1.64$) (Table 6). Following evaluation by external stakeholders, it was confirmed that participation in the cross-organisational CoP was linked to higher quality creative outcomes. The effect size for five of the factors indicates a medium to large effect ($d > 0.6$) (Cohen, 1992), while a medium effect is noted for the other two factors ($d > 0.44$). These values denote an effect of practical importance, in conjunction to the statistical significance of the findings (LeCroy & Krysik, 2007).

4.2. Conceptual knowledge gains for learners (RQ2)

Participants' exam scores ($N = 37$, with an outlier removed from the sample) ranged from 31 to 93 ($M = 61.78$, $SD = 15.44$) out of a 100 (Table 7). An independent samples t-test was conducted to examine mean score differences between the experimental and control groups. A statistically significant difference ($t(35) = -2.33$, $p = .025$, $d = 1.16$) emerged in favour of the experimental group ($M = 66.95$, $SD = 13.04$) compared to the control group ($M = 55.71$, $SD = 3.92$) with a large effect size (Cohen, 1992). In short, the experimental group outperformed the control group on the knowledge assessment test.

4.3. Differences in levels of group communication (RQ3)

Inquiry is a means of accessing expertise from respondents in the community (experts, mentors, instructors and other students) and, as such, it lies at the heart of CoPs (Wenger et al., 2009). Literature supports that inquiry correlates with student engagement and learning experiences as it creates multi-level interactions amongst CoP members (Garrison, Anderson, & Archer, 1999; Linnenbrink & Pintrich, 2003). It was therefore important to investigate and compare the frequency of interaction in the experimental and control conditions, as this would be an indicator of the learners' degree of involvement in and commitment to the work.

Multiple forms of blended interactions were recorded, both in the 'within-team' and 'community-wide' (experimental group) contexts. Information was extracted mostly from emails and feedback posts (Behance) (Table 8). Email exchanges between the teams and faculty (instructor and floating facilitator) in the experimental group ($N = 147$) were double the amount of those in the control group ($N = 72$).

Several communication transactions took place between students (experimental group) and *industrial* or *alumni mentors* who were providing feedback on student work. The Behance posts ($N = 125$) contained a total of 9,939 words ($M = 75$ words per post). This is analysed in detail in another study (author reference).

4.4. Perceptions of epistemic cognition (RQ4)

Three major themes emerged from the analysis of participant experiences. Namely, *Authenticity and Real-World Experts*, *Creative Constraints* and *Prospective Audience* were perceived as key motivators within the CoP encouraging learners' creative processes and outcomes. The following table presents the three themes and a detailed list of the concepts they comprise, broken down into *trigger* and *reaction* variables. Although the themes overlap to an extent, the variables are categorised based on the theme in which they are more prevalent (Table 9).

4.4.1. Authenticity and real-world experts

Participants valued the authenticity that emerged through their

Table 6
Comparison of Website Creativity Evaluations' (WSCMI) independent samples t-test for experimental and control groups

	Experimental			Control			*t*	*df*	*p*	Cohen's *d*
	N	*M*	*SD*	*N*	*M*	*SD*				
Aesthetically appealing design	167	3.89	1.28	143	2.97	1.60	-5.46	271.03	< .001	0.628
Interactive design	173	4.30	1.20	144	3.30	1.51	-6.37	270.15	< .001	0.727
Novel and flexible design	173	4.00	1.27	144	2.97	1.50	-6.52	281.67	< .001	0.742
Affective design	170	3.76	1.30	144	2.73	1.60	-6.21	274.80	< .001	0.710
Important design	173	4.22	1.17	143	3.47	1.61	-4.66	253.58	< .001	0.535
Common and simple design	172	3.45	1.31	144	2.81	1.34	-4.23	301.63	< .001	0.478
Personalised design	173	4.01	1.52	143	3.28	1.72	-3.91	286.39	< .001	0.444
Overall mark	173	5.77	1.67	144	4.34	2.26	-6.31	258.22	< .001	1.223

Table 7
Experimental and control group exam scores' independent samples t-test

	Experimental			Control						
Exam scores	*N*	*M*	*SD*	*N*	*M*	*SD*	*t*	*df*	*p*	Cohen's *d*
	20	66.95	13.04	17	55.71	3.92	-2.33	35	.025	1.167

Table 8
Frequency of communication in experimental and control groups.

	Faculty members			Alumni mentors			Industrial mentors	
Group	Project	Team emails (threads)	Team emails (unique)	Alumni mentors emails (threads)	Alumni mentors emails (unique)	Behance feedback posts	Client emails (threads)	Client emails (unique)
Exp. (CoP)	1	10	20	3	5	27	8	10
	2	9	23	2	12	21	6	15
	3	9	37	3	13	24	10	24
	4	7	20	2	6	26	1	1
	5	19	47	4	9	27	4	8
	Total:	54	147	14	45	125	29	58
Control	1	1	1	n/a				
	2	11	42					
	3	8	16					
	4	5	13					
	Total:	25	72					

Table 9
Themes, respective trigger, and reaction variables.

Themes (motivators)	Trigger	Reaction
1. Authenticity & Real-World Experts	1.1. Early industry experience	a. Challenged
	1.2. Expert mentor's status	b. Sincerity and commitment
	1.3. Similar trajectories	c. Increased time and effort
	1.4. Well-documented feedback	d. Better creative process and outcomes
2. Creative Constraints	2.1. Complex, vague or inconsistent requirements	a. Creative problem-solving
	2.2. Delays	b. Reformulation of requirements
	2.3. Strict, negative or conflicting feedback	c. Reformulation of design strategies
	2.4. Missing material	d. Extensive research
		e. Well-organised collaboration
3. Prospective Audience	3.1. Public judgement	a. Changed perception of achievement
	3.2. Professional portfolio	
	3.3. Industry reputation	b. Responsibility
	3.4. Career potential	c. Quality vs strategic outcomes

participation in the CoP. While challenging, the chance to catch a glimpse of the industry in which they hoped to forge a career was a distinctly motivating factor for the students. The projects (assigned and supervised by CoP members) bolstered their sense of commitment, making them approach their work more seriously, regardless of the strain on their schedules and existing workloads.

Team E, member: (1.1, a, c)*	It's real, it's authentic, the point was for us to live the experience (…) we saw ahead - whatever we were doing and now we know how it's going to be. If it hadn't been for them [the CoP members], it would have been less of a challenge… they made it more difficult, but they helped.
Team A, member: (1.1, a, b)	It's challenging! I dealt with the industry while still a student and I approached it more seriously (…) for me, this was motivating.

* Parentheses refer to the items under the themes and variables in Table 9

Interaction with alumni mentors and clients exposed participants to typical Design industry practices. While the CoP exchanges were challenging to navigate (compared to their usual university projects), students ultimately found them beneficial in light of the creative processes and outcomes that were made possible. Students reported that the benefits were grounded in the valuable, authentic and well-supported feedback from real-world experts who had taken similar trajectories to theirs:

Team A, project manager: (1.1, d)	It helps [the creative process]… I believe that it is much better, because we get to experience new and more professional practices.
Team C, member: (1.2, 1.3, a, b, d)	To have someone who graduated from the same studies to you, as your mentor is truly beneficial [for the work process and outcomes]. They have been through all of this and they know.
Team B, project manager: (1.2, 1.4)	People leave comments on Instagram too – but it's different when it's coming from an expert who supports and documents your work!
Team A, member: (1.1, 1.4, d)	[Referring to the quality of the outcomes] I would not be able to create everything on my own [without the CoP feedback] and I would have had the illusion that I was doing well…

4.4.2. Creative constraints

Creative constraints, within the context of this study, refer to the CoP-originating problems, that initiated a series of creative problem-solving processes in the collaborative student teams. Participant responses revealed interesting insights about the role of these constraints in generating creative performances. In this study, participation in the CoP presented constraints in the form of complex, vague or inconsistent

requirements, delayed responses to students' questions, extensive feedback and missing resources and material.

The role of constraints constituted a key discussion point with participants, specifically as to whether these inhibited or enabled their creativity. Ultimately the consensus was that the limitations faced in their CoP interactions, particularly with the external members, steered the teams' creative problem solving processes:

Team C, project manager: (2.1, 2.2, a, c)	Whatever steps we did at the beginning we needed to revisit afterwards… [for example] … She [the client] considered it ok and wouldn't send comments [on time], so we would move on… but then she would tell us 'I don't like this' - when we'd had already moved on… so we revisited the work (...) and we invested double the effort.
Team B, project manager: (2.2, 2.3, a, c)	I experienced the difficulties of the industry and I got a taste of that (…) and it was very positive for me [referring to problem solving].
Team C, member: (2.1, 2.3, a, b, c)	[The constraints imposed by the client] sometimes encourage you to be creative… it is better because you have a basis (a frame) to work from.

With regards to missing material, one key incident was also recorded in the instructor's field notes, in which Team C reacted by recreating the client's corporate identity and redefining all associated elements (i.e. web colour palettes, typography, layout):

Team C, member: (2.4)	Basically, they don't have a logo and they don't know anything about their colour scheme!

This real-life ill-structured setback, resulted in the need to engage in problem (re) construction process to reformulate the original requirements and respective design strategy. The members also decided to research other similar case studies online (2d) and contemplated different approaches to address the issue of missing materials. They also found that they needed to work in a more organised manner as a team in order to avoid compromising the project's quality and time-schedule. As such, they tried to stay on track with their creativity standards on the one hand, and the timing of their deliverables, on the other. These constraints obligated students to get involved in additional loops of creative problem solving and decision making:

Team D, member: (2.3, b, c)	They gave us feedback on our work… and then we started to think about it, and we started to review ideas in order to change things.
Team D, project manager: (2.3, a, b, c, e)	[Referring to critical CoP feedback] … you should be open-minded enough to change [the design plan], as your goal is to produce something good [for the industry] and not get stuck on your own ideas.[as a result, the team changed their design plan] (…) We took two days and changed it completely!

4.4.3. Prospective audience

It was clear that the CoP had created key prospects for the students in terms of a) the end-audience of their work and b) other potential benefits (i.e. reputation and career opportunities). The students thus valued the prospects resulting from the relationships developed in the CoP, which acted as a push for their learning commitment and work creativity. The prospect of their website 'going live' (published) had an overall transformative effect on their attitude toward the project. The possibility of real, public 'judgement' pushed them to work more creatively instead of pursuing a strategic, grades-driven approach, which may often be the case in traditional academic assessment conditions. It was widely agreed that even if the work was not ultimately published, a real-world project, assigned by real clients and guided by real industry experts, which would feature in their resume and work portfolios, held great value in itself.

Team A, member: (3.1, b, c)	[They were more creative because] it's different to know that it's a university project that won't end up anywhere, but with this one [the real project] you know that there is a chance it will go live and people will see it and you will be judged (…) you will have the responsibility.

Likewise, students found that they had reframed their prior perceptions of achievement according to the new standards that were (explicitly and implicitly) communicated through the CoP. As a result, they expressed their motivations in developing better, standard-compliant websites, that could enrich their portfolios, help build a reputation in the industry and generate prospects for professional collaborations:

Team A, project manager: (3.2, 3.4, a, c)	It was a push for me to work more creatively and develop something that is up to their standards… well, at least as close as possible to these standards (…) I want to become a web designer, and these are professional companies… and this is my portfolio I'm building… so for me this was motivating.
Team B, project manager: (3.2, 3.3, 3.4, a, b, c)	[We were more creative because of] the fact that we had to deliver something to a potential client or future collaborator… it's a good process, urging us to work better (…) and also end up with a real-world project in our portfolio.

5. Discussion

The objective of this study was to investigate the impact of a cross-organisational CoP on student learning outcomes. Specifically, the study aimed to measure the CoP's effect on the participants' *epistemic cognition*, through quantitative analysis of their creative outcomes (websites produced - RQ1), knowledge gains (final exams - RQ2), and frequency of communication (RQ3), as well as through the qualitative analysis of their *epistemic cognition* perceptions (RQ4). Aside from the *knowledge* itself (RQ1 and RQ2), these perceptions (variables) refer to *how* the knowledge was co-created, the *justification* of why it constitutes knowledge and the *ways* in which it *is or can be transferred* (Greene & Yu, 2016; Sandoval et al., 2016). The present work discusses and reports on these variables (RQ4) as follows:

5.1. Co-created knowledge

Through comparison of a control versus an experimental group (CoP condition), the study elicited significantly better results for participants in the latter, in terms of both the learners' creative outcomes (websites) (RQ1) and knowledge gains (exams) (RQ2). Both indicate a medium to large effect, which suggests that this difference in student outcomes is meaningful and bears practical implications, especially for instructors and researchers who are interested in improving their learning designs through CoPs (LeCroy & Krysik, 2007).

These outcomes link back to two epistemic cognition variables, primarily, the *knowledge* itself, as well as the *transfer* and integration of that knowledge into the websites produced by the student teams who were members of the community.

5.2. How knowledge was co-created

The higher frequency of team communication in the experimental versus the control condition, especially in the category of email exchanges with faculty members (instructor, floating facilitator, students) (RQ3), indicate greater levels of interest and engagement for the experimental group (Garrison et al., 1999; Linnenbrink & Pintrich, 2003). Overall, the volume of communication threads and feedback between the external members and students in the CoP (experimental condition only) reflect the epistemic cognition factor of *how knowledge is*

co-created.

Data from the focus group interviews confirm this too. Although considered laborious, participants commented on the value of learning from systematic expert reviews and feedback, as well as the chance to experience the practices of real-world experts and clients in authentic projects. This is evident in the 'Authenticity and Real-World Experts' theme. As such, the informal knowledge-creation interactions within the CoP augmented the learners' formal education processes and enhanced their learning gains. Such cross-organisational "constellations" (Wenger et al., 2009) are at the core of innovative learning, as competence, which is highly situated in certain contexts (i.e. industry), moves beyond its traditional boundaries, becomes negotiated amongst various members and thus enriches the different spheres (i.e. education) of the CoP (Tsoukas, 2002).

5.3. How knowledge was justified

Analysis presented in both the 'Authenticity and Real-World Experts' and 'Creative Constraints' themes provides strong evidence of knowledge *justification* episodes, in other words, indications of why learners judged that the information that was exchanged and the meaning that was negotiated in the CoP (mostly through feedback) was reliable and valuable (Conee & Feldman, 2004; Greene & Yu, 2016).

In their testimonies, students stated that they critically evaluated a) the *feedback*: they often verified this content by researching and checking against theoretical sources and by investigating similar cases online, therefore engaging in a systematic inquiry and justification process, and b) the *feedback contributor*: as reported, the contributors' credibility depended not only depending on their status and expertise, but also on the evidence and documentation they provided to support their feedback. The students reported making judgements about the veracity of this information and in fact stated the superiority of this over other types of feedback - such as that posted on public forums and social networks - based on how well the contributors documented and justified their reviews (Murphy et al., 2012).

5.4. How knowledge was transferred

As reported in the 'Creative Constraints' theme, every 'limitation' introduced by CoP members ultimately boosted creative problem-solving activity: teams had to make sense of complex, ill-defined or inconsistent requirements, strict, negative or conflicting feedback, missing material and delays. In response, they had to interpret (problem definition and construction) and often reformulate the requirements, evaluate and rethink their design and strategies (idea evaluation and selection), and streamline their collaboration processes to maintain both the quality and timing of their deliverables. Such ill-structured real-life constraints imposed by the cross-organisational CoP in fact helped students to *use* these to their benefit and steered higher levels of creative activity itself (Harms, Kennel, & Reiter-Palmon, 2017; Hofer & Bendixen, 2012; Onarheim, 2012).

In addition, CoP-derived constraints had the effect of gradually transforming learner perceptions of achievement (and associated criteria) and encouraging them to *use* their new perceptions to guide their work. This was prominent in the 'Prospective Audience' theme. In effect, these newly reformed views of what constitutes achievement motivated students to become more responsible in their learning, adopting a quality (performance-driven) rather than a strategic (grades-driven) approach to their objectives. This was not only pushed by the prospect of having their work scrutinised and evaluated by the wider community (Lave & Wenger, 1999), but also by the need to develop a strong professional work portfolio, a solid industry reputation and promising career opportunities, all of which emerged as a result of their participation in the CoP. In effect, the CoP placed these learners one step closer to the industry's expectations of creativity, while they were still at university.

The study has analysed and provided evidence of the positive effects on learners' *epistemic cognition* that can be achieved via participation in a cross-organisational CoP. The findings are significant: while knowledge, as meaning, fluctuates and may eventually become obsolete, the skill of determining how to *co-create* and *negotiate* meaning, and hence, knowledge, what *sources of knowledge* are of value and how to manage and *transfer* knowledge, within the context of a specific discipline, is critical.

The most obvious limitation of the study is the nature and size of its participant sample. The sample was drawn from a population of students in a specific department of a public university who belonged in two pre-existing classes which formed the control and experimental groups (convenience sampling). Combined with its small size (38 students) and the quasi-experimental research design employed, it is difficult to generalise the findings to an audience with different demographics. It would be interesting to run the study and investigate whether similar results can be found in diverse, larger samples. That said, to ensure transferability and replicability, we believe we have provided adequate thick descriptions about the research and its findings. The sum of these steps helps ensure that other researchers can adopt this CoP model and explore its learning potential within different samples in diverse contexts easily.

This study is in effect an evaluation of a cross-organisational CoP model in HE. The social capital, structure and, crucially, the distinct participation incentives have been described in detail in order to inform the design of similar social / community infrastructures. The study should be valuable to those aiming to bridge the gap between HE and industry in the field of Design, aiming for enhanced creativity and epistemic cognition. Others can use the study's design elements and findings to improve their own learning environments.

6. Conclusion

This work presents evidence of the positive effects of a cross-organisational community of practice (CoP) on learner creativity as well as actual and perceived epistemic cognition.

Three prominent themes related to learner participation in CoPs, namely 'Authenticity and Real-world Experts', 'Creative Constraints', and 'Prospective Audience' have emerged as the key motivators behind these positive epistemic effects. The study draws links between these themes and specific *epistemic cognition* variables, such as perceptions about the *co-created knowledge*, its *justification,* and its *transfer and application* into creative work processes and products.

The work's outcomes have implications for instructors, designers and practitioners interested in the design, steering and evaluation of cross-organisational CoPs. The key contribution of this research lies in its delivery of a technologically and practically transferable model that can support and augment learning via and toward authenticity and creativity, localised in the field of Design and its relevant disciplines.

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