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Author/s:
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Title:
Validating the ILETC's Teacher Transition Pathway

Date:
2019

Citation:
Imms, W. & Mahat, M. (2019). Validating the ILETC's Teacher Transition Pathway. Imms, W (Ed.) Mahat, M (Ed.) Transitions18 Continuing the Conversation, pp.1-232. The University of Melbourne.

Persistent Link:
https://hdl.handle.net/11343/240733

TRANSITIONS18

CONTINUING THE CONVERSATION

SYMPOSIUM PROCEEDINGS 2018



ILETC INNOVATIVE LEARNING ENVIRONMENTS AND TEACHER CHANGE

TRANSITIONS 2018

What are teachers doing (well) when transitioning from traditional classrooms to innovative learning environments? An international symposium for graduate and early career researchers.

Imms, W. & Mahat, M. (Eds.). (2019). *What are teachers doing (well) when transitioning from traditional classrooms to innovative learning environments?* Proceedings of international symposia for graduate and early career researchers in Australasia, Europe and North America. Retrieved from: http://www.iletc.com.au/publications/proceedings/

Organized by ILETC, the Innovative Learning Environments and Teacher Change.
ARC Linkage project (2016-2019). This research is supported under Australian Research Council's Linkage Projects funding scheme (project LP150100022).

Abstracts and full papers were subject to peer-review in line with HERDC specifications.



Australian Government
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We would like to thank Joann Cattlin, Roz Mountain and Lachlan Stewart for their contributions to Transitions.
The project would also like to thank the ongoing support of its partners.

ISBN 978-0-7340 5505-7

Cover photo: (*clockwise from left*) Nordagerskolen, Teddy Strandqvist photography; Anglican Church Grammar School, Brand and Slater Architects; Missouri Innovation Campus, ©Michael Robinson Photography, courtesy of DLR Group.
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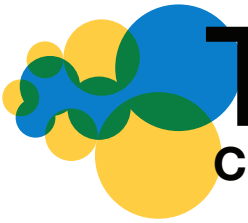

TRANSITIONS18

CONTINUING THE CONVERSATION

What are teachers doing (well) when transitioning from traditional classrooms to innovative learning environments?

An international symposium for graduate and early career researchers

Edited by Associate Professor Wesley Imms and Dr Marian Mahat

Preface

Transitions 18 was a trans-disciplinary research symposia held on 1st June 2018 in Melbourne, Australia, 8-9th October 2018 in Phoenix, USA and 15-16th October 2018 in Copenhagen, Denmark.

The papers in this volume underwent double blind peer review in line with HERDC specifications.

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Teachers' transition into innovative learning environments – An international synthesis of current knowledge

Wesley Imms, Marian Mahat, Chris Bradbeer & Joann Cattlin.
The University of Melbourne

Introduction

Transitions is a trans-disciplinary, research symposium focusing on innovative learning environments in schools and higher education. As a component of the Australian Research Council's Innovative Learning Environment Teacher Change (ILETC) linkage project, Transitions 2017 opened the door to an international conversation about realizing the potential of innovative learning spaces. Transitions 2018 continued the conversation by considering what teachers are doing (well) to transition from traditional spaces to innovative learning environments. As occurred in previous events, the 2018 symposia served two purposes. The first was to build a network of researchers from across the globe. The second was to use the event to validate findings from ILETC ongoing research.

The Transitions18 events in Melbourne, Australia; Phoenix, USA and Copenhagen, Denmark in June and October brought together 249 researchers and participants from over 20 countries and featured presentations, discussion and workshops exploring teachers' use of innovative learning environments from a wide range of academic and professional perspectives—extending the network beyond just graduate and early career researchers. Through the careful sequencing of papers, and considered input from expert interlocutors, Transitions18 explored the strategies teachers use working in ILEs; teachers' adjustments to changes in learning spaces, as well as the challenges for teachers in adapting to new spaces.

The number of participants at each event was intentionally kept to around 70 to enable effective discussions and interactions with presenters. Each event was held in quite different learning spaces and participants were able to utilise the different affordances of each. The Melbourne event was held in the Forum Theatre located in the award-winning Arts West building at the University of Melbourne. The Phoenix event, held at the new Canyon View High School, utilised different spaces for delivery of presentations. Participants had an opportunity to meet and engage with the principal, staff, architects and school board while receiving an in-depth tour of the campus. In Copenhagen, the University College Carlsberg provided a traditional lecture theatre space and the opportunity to explore the Future Classroom Lab (Denmark) with trainee teachers.

Structure of Symposium

Transitions was a working symposium, with new knowledge being generated and research findings being validated from the exchange of ideas occurring around each presentation. Participants presented combinations of 10, 20 and 30-min summary of their research. There were no concurrent sessions—all participants listened to every presentation. The papers in Melbourne were grouped differently to those in Phoenix and Copenhagen due to a longer program and wider range of topics presented at the overseas events.

At the end of the presentations in each theme, expert interlocutors (Chris Bradbeer, Scott Alterator, Clare Newton and Jill Laughlin in Melbourne, and Chris Bradbeer in Phoenix and Copenhagen) discussed key arguments that had emerged, drew inferences, and then elicited audience discussion on issues pertinent to each theme. Audience participation was encouraged and robust, drawing perspectives from various sectors including

fellow higher degree researchers, industry representatives from design, building and ICT, academics working in this field, and those embedded in implementing new classrooms at a policy level. The symposia were an intense and highly informative exchange of ideas.

In Phoenix and Copenhagen, participants were also asked to select the 'grand themes' that emerged from each presentation using an interactive online form. These 'grand themes' emerged from a synthesis of qualitative and quantitative data collected in Phase 1 of the ILETC project. At these two events, the project team also presented an overview of the ILETC project including results of the study thus far. Additionally, the team ran a workshop, that aimed to elicit participants' perspectives on the 'grand themes' that offered opportunities to challenge established teaching practices for different transition stage of a fictitious school. The results from the online forms and workshops are discussed in the chapter 2.

Structure of the Proceedings

The papers included in this volume, *Transitions18: Continuing the conversation*, were submitted by presenters who wished to develop their presentations into a full paper. Each paper was double blind peer-reviewed, and the comments sent to authors in order to help them prepare a revised version to strengthen the continuity and congruence of the proceedings. The result of this revision process is the backbone of this volume and represents what we consider to be a stimulating and careful set of analyses about how teachers transition into innovative learning spaces. An overview of each paper is provided below, which highlighted the common themes (which highlight the common themes and different perspectives within each topic), and different perspectives within each topic. The papers within the volume are ordered alphabetically.

CONSULTATION AND COLLABORATION IN THE DESIGN PROCESS

A number of papers highlighted the importance of consultation and collaboration in the design process, to not only overcome barriers to new spaces being utilised effectively, but also in developing a shared educational vision in school communities and sense of ownership of the spaces. These papers identified many commonalities in development of learning spaces in the very different educational systems of Ireland, Belgium, Denmark and Italy.

In partnership with the Irish Department of Education and Skills and various stakeholders, Barry's study (p.47) focused on an overarching research question 'How do we negotiate innovative school design, which places the learning process at the centre, in state funded post-primary schools in the Republic of Ireland?' Using an Educational Design Methodology, her study focussed the process of conceptualising and final delivery of new learning spaces in two Junior Schools.

Built on previous work conducted at KU-Leuven as part of the Flanders-wide Active Learning IN the Association (ALINA) project, Binnard and Peeters (p.53) sought to understand the 'vicious cycle' between the provision of new learning spaces and the adoption of contemporary pedagogical approaches. Through the collection of survey data, interviews and focus groups, the authors gained a thorough understanding of existing barriers, which led to a series of recommendations for policymakers and lecturers.

Bøjer (p.67) leveraged the principle of 'design after design' (Lundsgaard, 2011) to investigate post-design participatory research aimed to support primary school teachers' transition into ILEs in Denmark. Three co-design workshops incorporating co-created furniture provided a series of provocations for teachers, from which data were collected. The approach was found to provide valuable opportunities for teachers to reflect on their evolving pedagogical and spatial practices, and a means to support their transition into new spaces.

Using an action research methodology, Marcarini, Filios and Arnaldi (p.145) proposed a renovation and re-organisation of a school in Italy based on engagement with various stakeholders. They found that the collaborative design processes led to teachers' and students' developing a positive school identity, as well as encouraging an environment that supported the exchange of experiences, ideas and different visions of the world.

Tomasoni and Raimond (p.201) argued that collaboration between different stakeholders is necessary to the design of school environments. In their paper, they demonstrated that a creative and participatory approach that includes teachers and students is a good way to introduce and encourage new usage habits within innovative learning environments. Although time consuming, the collaborative approach ensured a higher probability of success of ILEs.

IMPACT OF SPACES ON STUDENTS

The impact of spaces on students learning outcomes, skill development, inclusion, engagement and wellbeing was explored by papers from Portugal, Italy, Canada and Ireland. These studies investigated both individual spaces and whole schools and demonstrated the deep connections between development of innovative spaces and student-centred pedagogy.

Baeta and Pedro (p.39) utilised the Linking Pedagogy, Technology and Space observational metric (Byers, 2017) to investigate teacher practice in three Portuguese public schools. Their findings indicated that the highest levels of student learning outcomes were recorded in those classrooms where teachers adopted more student-centric approaches. Particularly notable in these cases was the amount of teacher time spent facilitating learning through feedback, the monitoring of the learning process, and providing time for students to engage with learning tasks.

In a research project which is being carried out by the National Institute for Documentation, Innovation and Educational Research (INDIRE) in Italy, Carro, Mori and Panzavolta (p.95) investigated the impact of psycho-socio-cognitive variables when school environments are restructured. The objective of the study was twofold: to gain a better understanding of the interrelation between the dimensions of wellbeing—which include strategic, emotional-affective, socio relational and physical well-being; and to examine the relationship between the adoption of active teaching methods and the reconfiguration of a flexible space.

The idea that current discourse promotes students' exposure to and engagement in complex problem-solving tasks led Chiasson (p.109) to challenge us about the need to understand the process of Computational Thinking (CT) in relation to learning spaces. His case study examined how students in a Canadian middle school engaged with problem perception, decision, execution and feedback in the context of a robot programming activity. The findings suggest that a space that is multifunctional, engaging, diversified, comfortable and technology-rich, has the potential to support students to solve complex problems.

Moran (p.153) sought to measure changes in student engagement when a whole school approach is taken to changing the learning environment. Following a study which employed Thornburg's (2013) archetypal learning spaces within a Catholic secondary school in Dublin, she found that students were achieving above their expected level of performance on CAT scores. The implication is that effective use of ILEs to diversify the teaching and learning methodologies enable students to be creators of their own learning, support skills development and allow greater interaction between teachers and students.

In their study, Scevola and Sassone (p.191) described an experiment to modify learning spaces, into what is called the "colour spaces" for the benefit of didactic innovation. Data was collected through direct observations and surveys of teachers and students who use the spaces. The findings suggest that the adoption of didactic approaches based on active and experiential learning can help support skill development of students.

Sandri and Marcarini (p.183) described an ongoing exploratory study aimed at understanding the organisation of learning spaces for the inclusion of all students, especially those with severe learning disabilities. Findings suggest that teachers in inclusive schools are more aware of the organisation of the learning spaces, knowledgeable about the flexible settings that support inclusion, and use multiple teaching strategies to encourage individualised learning.

IMPACT OF LEARNING SPACES ON TEACHERS

Given the focus of the symposia on teachers, it was not surprising that a significant number of papers addressed teachers' responses to learning spaces. These papers considered learning spaces as a professional learning environment for teachers, explored concepts of ownership of shared spaces, collaboration with other teachers, change management leadership, teacher agency and implications of active pedagogy.

Blannin (p.61) utilised Harré and Langenhove's (1991) positioning theory to explore Australian primary teachers' use of learning spaces as a professional learning environment in the context of Web 2.0 digital technologies. Through analyzing use of language, positioning, personal learning and speech acts demonstrated in their teaching space, the study identified a range of informal supportive interactions occurring between teachers. The implication is that shared teaching spaces appear to facilitate moment-in-time learning and support for teachers as they navigate new technologies.

In his paper, Bradbeer (p.75) focussed on the concept of ownership, one finding drawn from a broader study on teacher collaboration in ILEs. Drawing on data from observations and interviews with teachers, students and school leaders, Bradbeer found different conceptions of ownership related to ILEs—spatial, administrative and pedagogical—which provided a useful lens to investigate teacher collaboration.

Using a mixed methods approach, Cannella, Chipa, Bori and Orlandini (p.87) described a study that aimed to investigate teachers use of active pedagogy in innovative school buildings. Data will be collected from four case study schools and it is expected that the findings will provide practical strategies and policy implications for Italian schools.

The paper from Carro and Mosa (p.95) was one of a suite of contributions from the National Institute for Documentation, Innovation and Educational Research (INDIRE) in Italy. It drew on a gallery of ideas and examples of schools that have modified spaces in order to move towards more contemporary models of learning, most particularly where space has been differentiated according to pedagogical activity.

Guldbæk Broens (p.117) argued that teachers transitioning to innovative learning environments could be the key to unlocking deep collaboration and joint commitment within teams of teachers. Her ethnographic study explored how, by observing each other and executing activities together, teachers incorporate peer learning as a natural professional development, which supports their practices both as individuals and as a team.

Knock (p.123) argued that the enduring effectiveness of ILE is considered reliant on the capacity of teachers to work as a team, challenging long-held beliefs of teaching as a solo profession. Her multiple case studies presented several implications—including vision and leadership, shared norms and systems and pedagogical approaches—for the successful development of teaching-teams in ILEs.

Further, Osborne (p.159) argued that without a clear understanding of how to lead change in teacher practice, many ILE implementations may be unsuccessful. His paper discussed the essential elements of a successful change process—preparing, implementing and sustaining—that can enable a well-designed facility to be implemented to its full potential.

Stewart, Morse and Scragg (p.197) described progressive and innovative work with local school districts to re-invigorate the teaching profession utilizing new differentiated roles and new designs in teacher education. They argued that moving from the one teacher one classroom model to a team of educators with distributed expertise in open and collaborative spaces will not only impact student outcomes, but also educators' job satisfaction and retention.

INTERACTIONS BETWEEN USERS AND SPACE

A number of papers used innovative approaches to investigate and measure the interactions between the users and the physical elements of learning spaces. These papers used a range of research methods to record data and analyse the impact of space, including video, personal tracking devices, observation, design thinking, photo elicitation and synthesis of experience.

Braga and Guttmann (p.81) employed concepts embedded within urban planning and social networks to develop a methodology to observe and classify flows of knowledge inside a vocational high school in Brazil. The researchers mapped exchange of ideas, information and equipment and developed a set of visualisation methods to explore flows of knowledge by using a set of video cameras during two problem-solving tasks. Their study identified that knowledge was transferred both explicitly and tacitly, leading Braga and Guttman to conclude that better understanding these knowledge transfer may potentially lead to more effective design and pedagogical solutions.

In this pilot study, Lan, Hui, Nantwi and Natriello (p.129) examined learner activity in an innovative learning space by using a real-time locating system (RTLS) to record learner movements around an educational technology exhibition. They argued that such data can enhance tangible, full-body and ubiquitous learning research and help educators and facilitators create personalized and adaptive learning experiences in innovative learning environments.

Lightfoot (p.137) used visual research, as part of a human-centred design project, to illustrate issues that children and teachers have with school furniture in a typical English primary classroom. In uncovering previously unseen impacts of school chair use, the findings demonstrated that visual research is a valuable tool for investigating the multiple meanings of designed objects in a classroom environment.

In her study, Peterson (p.165) described patterns of interactions identified through a novel conceptual framework and visual-research tool. Analysis of a hundred photographs taken and selected by ten teachers at two schools in Helsinki, Finland identified the importance of teacher agency and the efficacy of design choices to support teachers' life and work at school.

Salmon and O'Reilly (p.173) described a synthesis of findings through their work with school leaders including administrators, directors, trustees, and educators. Five key principles emerged for the use of furniture in schools: reduce the educator footprint, reduce the casework, shift the technology and share it, count the seats and change the scene. They found that schools embracing these principles are spending less on furnishings and discovering greater flexibility in their learning environments.

Tuckwell (p.209) examined the emergence of design thinking as an epistemological approach to interdisciplinary research, such as learning environments research. Drawing on the design thinking methodologies within the ILETC project, he argued that design methods can evolve alongside other research methodologies, situating design as augmenting the meaning researchers derive from research in areas of investigation across trans-domains of knowing.

Conclusion

Each year, Transitions supported greater connection between researchers and professionals in the emerging field of learning environments and has led to new collaborations, international exchanges, greater access to new research and deeper understanding of international practices in school design, pedagogy, evaluation and teacher training.

The papers in these proceedings indicated that internationally there is significant research efforts addressing how learning spaces impact on students' learning and teachers' practice, how the design process can influence the success of spaces and what research approaches provide useful data to inform these issues. Many of the research projects featured in these proceedings involved significant collaboration between governments (from national to regional), academics, professionals and industry. They also reflected a strong cross-disciplinary interaction between the fields of education, design, architecture and featured opportunities for developing a shared understanding of the complexity of developing and using learning spaces.

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Validating the ILETC's Teacher Transition Pathway

Marian Mahat, Chris Bradbeer, Joann Cattlin and Wesley Imms
The University of Melbourne

Introduction

Demonstrating the validity of findings in order to ensure credibility is a key juncture in any research (Creswell & Miller, 2000). At this stage of the Innovative Learning Environment & Teacher Change (ILETC) project, what was important was to undertake procedures to validate inferences (Hammersley & Atkinson, 2007) drawn from the ILETC Phase 1 data. Specifically, this related to the temporal dimensions and Grand Themes initially identified through Phase 1, and subsequently conceptualised as the Teacher Transition Pathway (ILETC, 2017).

The project team leveraged the collective expertise gathered in Transitions18 research symposia in Phoenix, USA, and Copenhagen, Denmark, to undertake a series of validation processes. This chapter describes the data collection methods used for validation, along with results obtained. Comparison is made between the two venues. Implications for the next stages of the project are discussed.

Teacher Transition Pathway

Utilising a range of quantitative and qualitative data collection methods (including systematic literature reviews, a series of teacher workshops, a survey of principals, case studies as well as symposia and think tank meetings), data was collected in Phase 1 of the ILETC project involving 1,300 participants internationally. Analysis of data from Phase 1 was emergent, with data collection and analysis forming part of an ongoing and interconnected process. This took the form of thematic analysis, a method developed from grounded theory literature (Glaser & Strauss, 1967) and content analysis (Babbie, 1979; Couchman & Dawson 1990; Downe-Wamboldt, 1992; Fox, 1982). The aim was to produce a detailed and systematic recording of the themes and issues addressed in various data collection methods and to link the themes together under a reasonable data-driven category system.

The analysis of data identified a common pathway teachers follow in the process of transition from traditional to more innovative learning spaces and practices. What emerged are three phases in the process of creating new learning spaces—early, implementation and consolidation—and the key issues to be addressed, articulated into a Teacher Transition Pathway. Taken as a whole, this constituted the pathway(s) along which teachers and schools travel as they grow their ILE-relevant mind frames.

The Teacher Transition Pathway (see Figure 1) summarises commonalities amongst teachers' multiple approaches to transition into an ILE. It found there exists a logical, reasonably common pathway that teachers follow as they transit into an ILE. This pathway constitutes of a large variety of change strategies. This pathway is highly individualised, both at the school and the teacher levels. While 'commonalities' exist, the reality is each school (and teacher) experiences unique challenges during this transition.

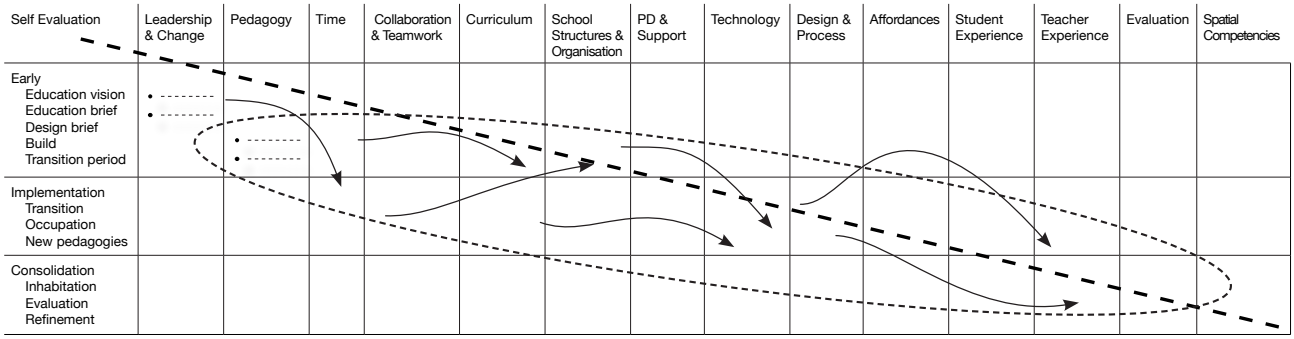

Figure 1. Teacher Transition Pathway. (Source: ILETC, 2017).

TEMPORAL ASPECTS

The data shows that there is a temporal dimension to the pathway. The early phase relates to the early stages of designing and building an ILE. The development of the education vision, education and design briefs and the actual build or refurbishment of the learning space forms an integral component of this phase. The implementation phase relates to the occupation of ILEs—a stage when both teachers and students move into and adapt to the new spaces. Finally, the consolidation phase relates to the long-term inhabitation and evaluation of the impact of ILEs. This is the stage where practices, design and affordances are continually refined to best meet the overall educational vision of each school.

GRAND THEMES

Further analysis of the data also illuminates some of the issues, which could be grouped into 14 'grand themes' that teachers face while transitioning into an ILE. These are leadership and change, collaboration, pedagogy, time, curriculum, school structure and organisation, professional development and support, technology, design and design processes, design affordances, student experience, teacher experience, evaluation and spatial competencies. These themes arguably represent the common issues being addressed by key stakeholders (policy, school administrators, teachers and researchers), as teachers transit from traditional spaces to innovative ones. An overview of the grand themes is provided in Appendix A.

STRATEGIES & TOOLS

It is possible from the data to make tangible the spatial learning tools that teachers use to turn strategies into actions which help them transit into an ILE. Here, a 'strategy' is defined as *an explicit concept, theory or practice* that the data indicated enhanced teachers' use of innovative learning environments, while a 'tool' is an *identifiable activity or protocol, that implements a strategy.*

The Teacher Transition Pathway provides a framework to house these strategies and tools in a temporal manner in keeping with what we observe of teachers to make the journey of change. These strategies and tools will include many that have been developed by our research team and project partners, by schools, by other organisations that have a keen interest on supporting teachers use space better, as well as new tools to be developed by the project. This pathway is continually being refined. The Transitions symposia in Phoenix and Copenhagen gave the project an opportunity to validate the grand themes.

Method

Two data collection methods were used: (1) online forms and (2) workshops. Participants from the Phoenix (n = 69) and Copenhagen (n = 74) symposia contributed to each of these data collection method.

Participants consisted of academic researchers, industry representatives (including architects, interior designers, acousticians, furniture designers, education consultants), education policy makers and principals or teachers. A summary is provided in Table 1.

Table 1.
Breakdown of participants

Role	Phoenix	Copenhagen	Total
Academic researchers	19	28	47
Industry (Architects/consultants/businesses)	28	26	54
Education policy makers	12	15	27
Schools (principals/teachers)	10	5	15
Total	69	74	143

In terms of the online forms, participants were asked to select the 'grand themes' that emerged from each research paper presented at the Transitions symposia. The rationale was that 'grand themes' were considered to be valid if research undertaken by scholars globally covered these themes. Presentations were grouped prior to the symposia into three foci—those that relate to the early, implementation and consolidation phases of the transition process. The number of presentations were unevenly spread over the three phases, for example there were very few presentations on the consolidation phase. Also, the number of responses varied across presentations and there were slightly more participants in Copenhagen than in Phoenix. To adjust for this, the frequencies are shown as a proportion of the total votes for each phase. An overview of the 14 grand themes (see Appendix A) were provided to participants at the beginning of each symposia.

In terms of the workshops, the aim was to elicit participants' perspectives on the 'grand themes' that offers opportunities to challenge established teaching practices for different transition stage of a fictitious school, Universal College (UC). Six scenarios were developed for the Junior, Middle and High School consisting of combinations of different phases and 'positive' and 'less positive' experiences of teachers. Participants were randomly grouped into sets of three. Each member of the group was allocated a persona—an architect, a principal and a teacher—and provided with one scenario (see Appendix B). They were given approximately 45 minutes to discuss one key question: *Thinking about your persona, which of the Grand Themes offer opportunities to challenge established teaching practices?*

Results

Results are presented here in visual format, grouped according to the phase of transition that was relevant—early, implementation, or consolidation. A comparison of the results between the Phoenix and Copenhagen symposia is also presented.

ONLINE FORMS

The frequencies of selection of each of the 14 themes are shown in Figure 2. The themes that occurred most frequently overall were *Student experience, Design and process, Design affordances* and *Teacher experience*. This aligns with a general trend in the field of learning environments to focus increasingly on user experience, and also to emphasise the role of users in the design process. The least common themes for all phases were *Curriculum* and *Time*. This may be due to a perception that these two 'variables' are more fixed than the others and tend not to be discussed explicitly as elements to address in optimising learning environments.

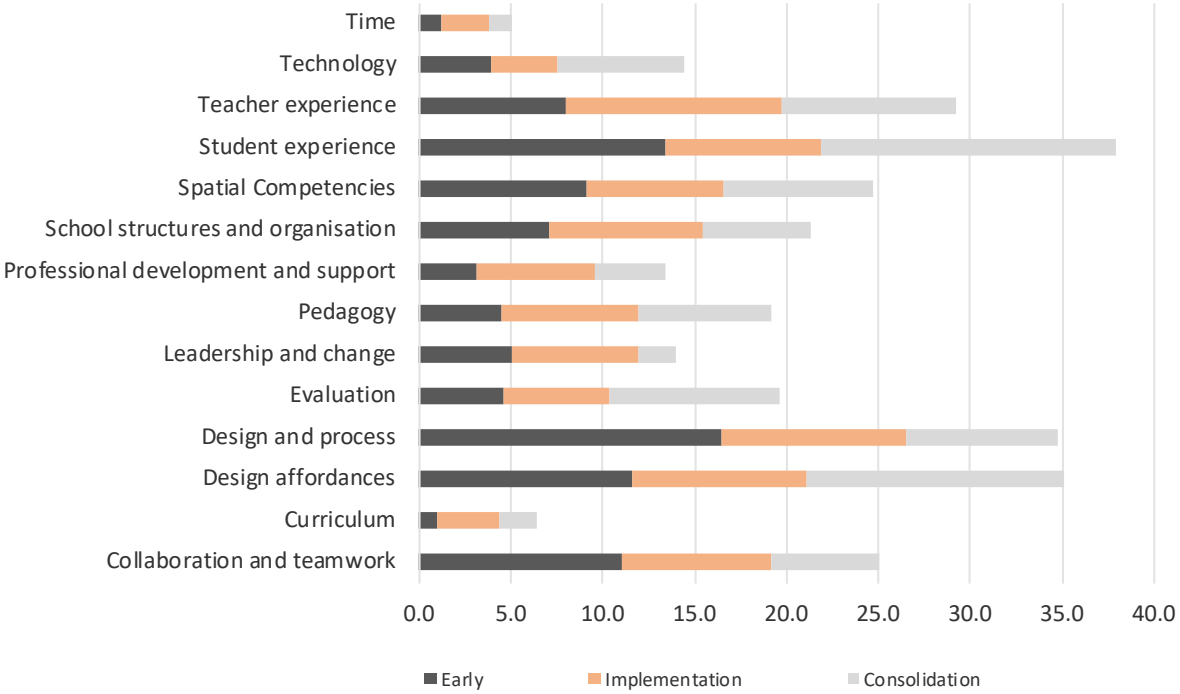

Figure 2. Number of times the grand themes were selected in each phase using the online forms.

For the early phase, the highest scoring themes were *Design and process*, *Student experience*, *Design affordances,* and *Collaboration and teamwork*. In the implementation phase, *Teacher experience* was the most prevalent theme. In the consolidation phase, *Student experience* and *Design affordances* were selected most frequently by far. The greatest shift in emphasis between phases was towards *Teacher experience* in the implementation phase, as well as themes aligned with teacher support such as *School structures and organisation, Leadership and change, Pedagogy and Professional development and support*. There was a shift from *Design and process* to *Evaluation* in the consolidation phase. The lower rating for *Collaboration and teamwork* in this last stage is less obvious.

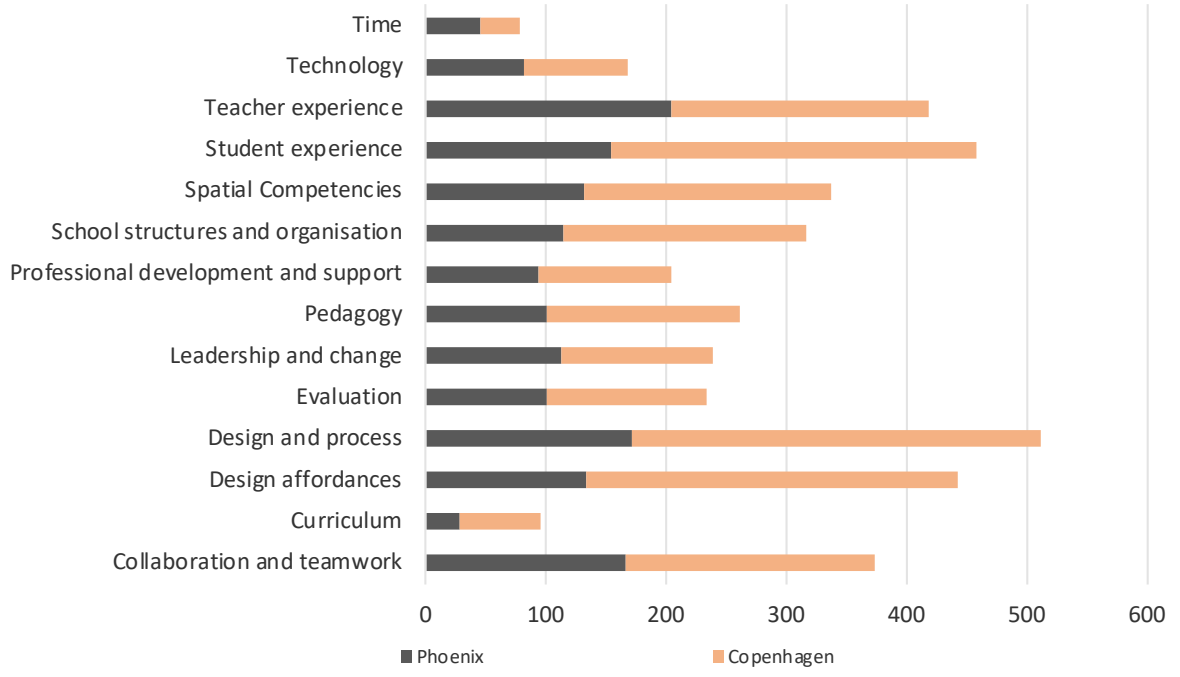

Figure 3. Comparison of responses from online forms by location.

There were some differences in emphasis between the results for Phoenix and Copenhagen. The presentations in Phoenix scored higher overall for *Collaboration and teamwork*, and *Teacher experience* than in Copenhagen, and lower on *Student experience, Design affordances,* and *Design and process* (Figure 3).

The pattern of responses in the two locations was very similar for presentations in the early phase of transition. In the implementation phase, *Teacher experience* was very strongly evident in Phoenix, whereas in Copenhagen, the *Design* aspects dominated: *Design and process* and *Design Affordances*. For the final consolidation phase, there were major differences in the themes between the two locations, most notably there was a much greater emphasis on *Evaluation*, *Technology* and *Spatial competencies* in Phoenix and a greater emphasis on *Collaboration and teamwork* in Copenhagen (see Figure 4).

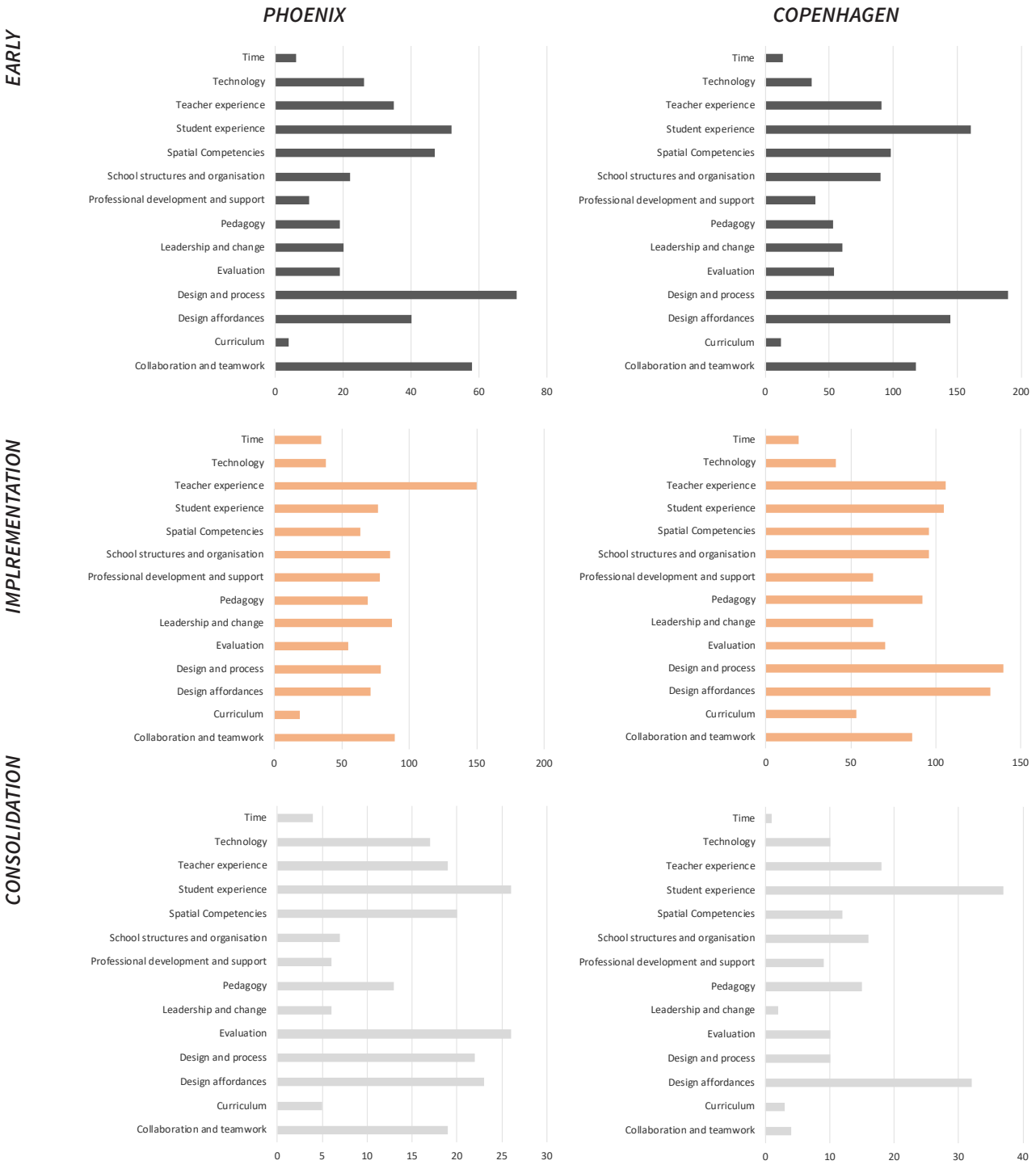

Figure 4. Comparison of responses from Online forms by phases and locations.

WORKSHOP

Six scenarios were presented, one per group, with participants assigned a particular role—architect, principal and teacher—to provide a perspective on the transition process. The scenarios represented a variety of contexts at the three stages of transition into an innovative learning environment: early (scenarios 1 and 2), implementation (scenarios 3 and 4), and consolidation (scenarios 5 and 6). See Appendix B for a description of the scenarios.

Workshop participants selected the grand theme(s) they considered most important in the scenario they were given. Overall, *Collaboration and teamwork*, followed by *Spatial competencies* and *Pedagogy*, had the highest number of votes (See Figures 5 and 6)

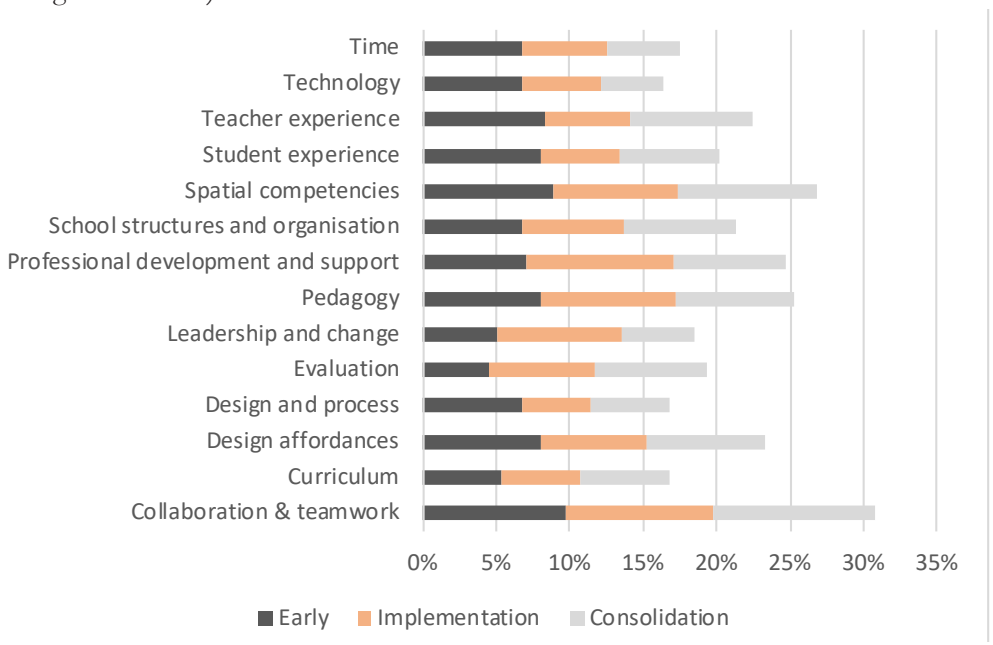

Figure 5. Comparison of workshop data by phases.

Analysis of the three different roles showed that 'architect' participants placed relatively more emphasis on *Spatial competencies*, *Design and process* and *Design affordances*. Principals placed greatest emphasis on *Professional development and support*, *Leadership and change* and *Collaboration and teamwork*, strongly reflecting their leadership role. Teachers chose *Collaboration and teamwork, Pedagogy,* and *Professional development and support* most frequently.

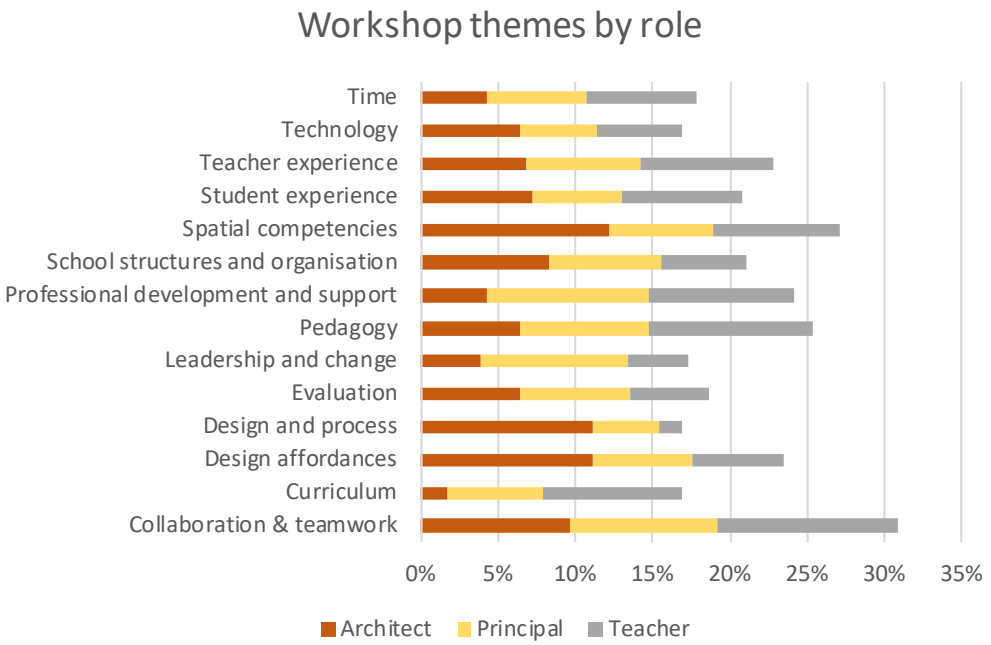

Figure 6. Comparison of workshop data by roles. (Source: Author, 2018).

Results for the workshops are presented individually for Phoenix and Copenhagen, for each phase (Figure 7 on next page) to allow for comparison. The pattern for the early phase results was very similar for Phoenix and Copenhagen, except that *Teacher* and *Student Experience* featured much more strongly for the architect role in Phoenix. Similarly, for the principal and teacher roles in the implementation phase, there were much higher scores for *Teacher* and *Student Experience* in Phoenix than in Copenhagen. *Leadership and change* in this phase is most highly rated in Phoenix, but did not feature strongly in Copenhagen, especially for 'architects' and 'teachers'. There is no clear similarity in the consolidation phase across locations. In Phoenix, the number of participants was lower and scenario 6 was not used, precluding any meaningful comparison.

COMPARISON BETWEEN ONLINE FORMS AND WORKSHOPS

Data from the online forms and workshops are presented side by side showing results by location (Phoenix or Copenhagen) in Figure 8. The relative importance of themes does not seem to follow a similar pattern for the presentations and workshops for either of the locations. The dominant themes that arose from the workshops seem to be more focussed on teachers' skills and ways of working with the most frequently-selected themes being *Spatial competencies*, *Collaboration and teamwork*, *Pedagogy*. By contrast, in the presentations, the dominant themes related to design (*Design and process* and *Design affordances*), and user-experience (*Teacher* and *Student experience*). *Time*, *Curriculum* and *Technology* scored the lowest. There was a more even spread of across the themes selected in the workshops. The results from the online forms showed a greater degree of differentiation between lowest and highest rated themes.

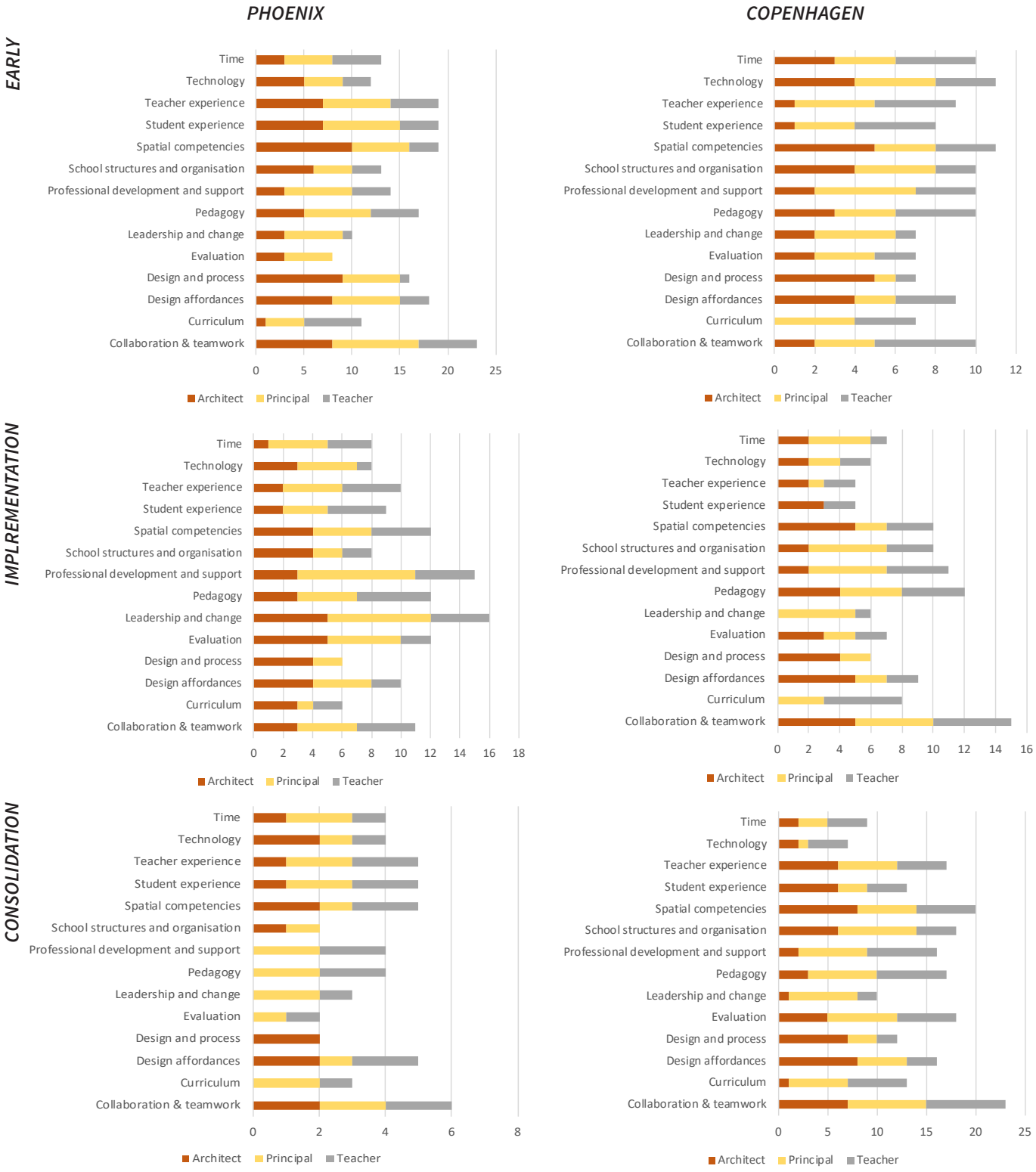

Figure 7. Comparison of workshop data by phases and locations.

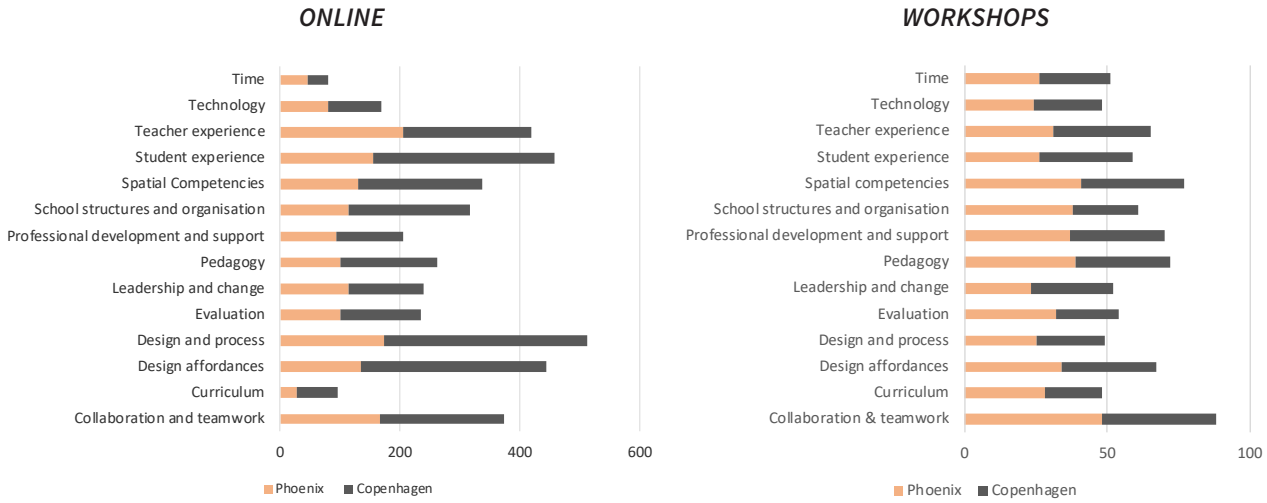

Figure 8. Comparison of responses by data collection methods and location.

Implications and conclusions

The Teacher Transition Pathway summarises key commonalities amongst teachers' approaches to navigate the transition into an ILE. This provides a mechanism to capture teachers' journey from traditional spaces to more innovative learning environments and identify resources that can support this transition. By consolidating the data from both methods—the online surveys and workshops, the grand themes can be re-arranged based on the total number of responses as well the responses for each phase. This is illustrated in Figure 9. This helps pinpoint the more critical grand themes at each stage of the transition process.

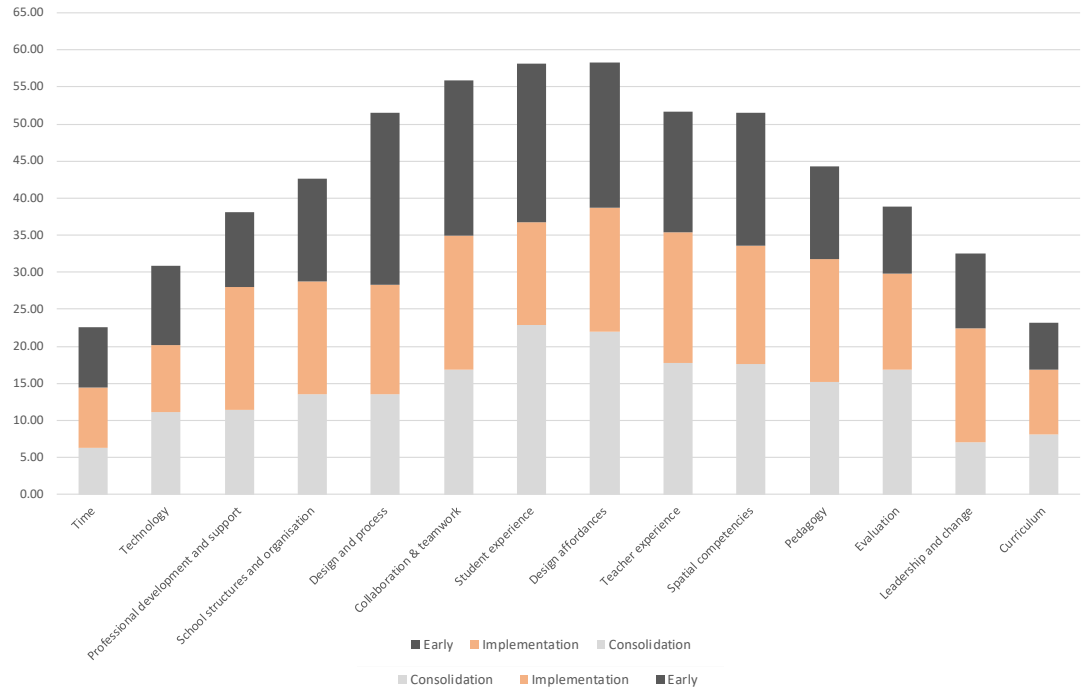

Figure 9. Grand themes based on total responses.

Although all the grand themes appear to be important at every phase of transition, some themes were more central than others. Student experience seem to be a key focus at every phase of the transition process. This recognises that well-supported and well-engaged students achieve the best possible learning experiences and understanding how spaces impact this is vital. Additionally, understanding what the space is capable of

(design affordances) appears to be key for teachers transitioning into an ILE. This is followed by developing collaborative practices and understanding how space impacts their teaching (teacher experiences). Both relates to teachers' agency to enact change-individually or collectively. At both ends of the spectrum, time and curriculum seem to be less significant in the transition process. This could relate to teachers' perceptions that they have less control over these matters.

If the results are transposed into the Teacher Transition pathway, the journey through which teachers travel to transit from traditional spaces into more innovative spaces can be illustrated in Figure 10. There is a common pathway (in grey) that teachers follow. However, each teacher experiences unique challenges during this transition and the spatial learning tools can help support teachers' effective transition, in highly individualized ways.

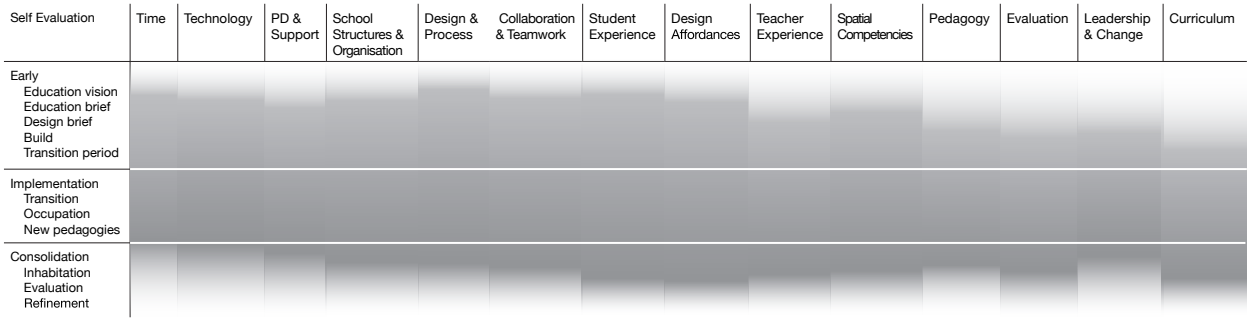

Figure 10. Reworked Teacher Transition Pathway. (Source: Authors).

These results provide preliminary evidence that the Teacher Transition Pathway is a robust framework for explaining teachers' transition into ILEs. Further inquiry into the grand themes would be needed to assess which of the grand themes would best support teachers' effective transition into ILEs. This would be conducted using an online survey of over 6000 schools in our educational partner jurisdictions. Such evidence will help support the development of resources to support teachers transition into ILEs.

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Appendix A: Grand Themes

Transition themes

Definitions

Collaboration & teamwork	Collective work undertaken by teacher, school or design teams; with a view towards solving a shared problem or meeting a shared need. Could be at teacher-teacher, student-student or teacher student level.
Curriculum	The formally (or informally) taught components of learning, including areas of learning (subjects), capabilities & dispositions; as well as those implied through teaching methods and school systems.
Design affordances	The term 'affordances' means the perceived and actual attributes and functional properties of an object that could be used to facilitate student learning.
Design and process	The progression of envisioning, planning & representing the architectural scheme for a building or conversion.
Evaluation	Assessment of educational and spatial outcomes e.g. student outcomes, teacher practice, spatial usage.
Leadership and change	The role of providing direction and exercising influence within a school setting.
Pedagogy	The specific approach teachers take to teaching (based upon their theories about learning), including design of learning experiences, assessment, models of learning – that together influence student learning.
Professional development and support	Intentionally designed interventions, or reflective experiences, that build capacity in teachers and school leaders. These may include intentional and unintentional learning, coaching, mentoring and courses.
School structures and organisation	The way in which schools organise time, space & people e.g. could relate to systems of scheduling time, structures of staffing, arrangements of students.
Spatial competencies	The way that teachers recognise, understand & utilise different space to maximise opportunities for student learning.
Student experience	How a student observes, encounters, interacts with, or participates in their learning and school.
Teacher experience	How a teacher observes, encounters, interacts with, or participates in their work and school.
Technology	In the context of this project technology is taken to refer to digital technologies, supporting infrastructure & connectivity.
Time	The temporal component of teacher transition, both short & long-term, for example building readiness, planning time, time-management, headspace.

Appendix B Workshop Scenarios

Scenario 1

UC's Junior School, in the 'early' phase.

The situation

UC's Junior School staff are a well organised and motivated group. They have an educational vision for their school that emphasizes student-centred, differentiated learning. These ideals are underpinned using well established and emerging educational theories, modified to suit UC's unique circumstances. The staff see quality teaching as the foundation for students to engage fully with their own learning.

The challenge

During recent years, the teachers have developed significant pedagogy development strategies. However, now that designs are being provided to them, they realise little of this pedagogical work uses space as a 'tool' for teaching and learning.

Scenario 2

UC's Junior School, in the 'early' phase.

The situation

UC's Junior School staff have little pedagogic planning as a school team in place other than a sense of 'what works intuitively'. They have an older staff that appears somewhat resistant to change, perhaps because s/he 'knows what works'. The new Principal is keen to lift the Junior School beyond what s/he feels are entrenched practices that arguably limits children's futures.

The challenge

The challenge here is to use the upcoming buildings to inspire re-thinking of what pedagogy best suits today's children. The Principal wants to know how the design process can be used to spark such a re-visioning? And if it does, how can staff concepts of good learning eventually be reflected in the preliminary designs?

Scenario 3

UC's Middle School, in the 'implementation' phase.

The situation

UC's Middle School staff have actively worked for five years on developing teaching strategies that assist students transition from the unique qualities of elementary/primary schooling, to the more disciplinary focused High School structure. They have engaged in professional learning on the topic, have a leadership team devoted to this issue, and regularly solicit student input on how to create an environment that facilitates good social, emotional and cognitive engagement for this group of students.

The challenge

Having moved into the new building a few months earlier, the staff now agree that they have inadvertently ignored the spatial. In particular, they now question how more flexible spaces allow teachers to replicate what was good about students' elementary/primary experiences

(mobility, project-based learning, collaborative teaching) while looking ahead at the rigorous High School years (increased teacher-centred learning, rigidly organised subjects, increasingly 'specialist' teacher skills). The Middle School leadership groups want to maximize the advantages these brand-new spaces offer, to accelerate their Middle School transition (and improved student engagement) philosophy.

Scenario 4

UC's Middle School, in the 'implementation' phase.

The situation

UC's Middle School staff struggle to see how Middle School differs significantly from High School practices. While some conversations occur that recognise how boys and girls of this age differ in terms of their educational needs, the predominant mentality is that Middle Schools are little more than a 'safe' High School environment.

The challenge

As a result, the new Middle School buildings, with their more open-plan design, moveable walls, increased break out spaces and more flexible furniture, have in the last nine months begun to resemble more and more a traditional classroom/corridor arrangement. Teachers remain at the front of their 'own' classroom, and students have restricted opportunities to collaborate, communicate, be creative, and be critical thinkers.

Scenario 5

UC's High School, in the 'consolidation' phase.

The situation

UC's High School staff have managed to reimagine, to some degree, the discipline-specific 'silo' effect typical of this level of education. Even before moving into the new building two years ago there was greater cross-disciplinary planning of coursework, and teachers discussing openly how allowing students freedom to access teachers and peers helps them address learning goals in ways more relevant to their personal interests and skills.

The challenge

Since inhabiting the new space, the leadership team have realized that the more open spaces allow greater learning and teaching flexibility. However, with little research into strategies for driving a spatial aspect to this work, the leadership team feels they are missing many rich opportunities.

Scenario 6

UC's High School, in the 'consolidation' phase

The situation

UC's High School staff say they are motivated to improve learning outcomes and prepare their students for life post-secondary. However, despite being in more flexible open spaces for two years now, practices in the spaces have been characterized by teacher-centred learning, rigidly organised subjects, and increasingly 'specialist' teacher skills. Semi-permanent walls have been constructed to ensure that students are not distracted, and

teachers remain at the front of their 'own' classroom providing teacher-facilitated direct instruction. The Principal feels that students have restricted opportunities to collaborate, communicate, be creative, and be critical thinkers.

The challenge

The Principal and the leadership team would like to utilise the new spaces to catalyse a change from teacher-centred learning. They would like to use characteristics of the new spaces to free student activity. The problem is, of course, how to get teachers to be involved in a productive way that facilitates the change required.

Keynote address - Melbourne & Copenhagen

Challenging transitions: Reflections from 30 plus years of learning deeply with educators and architects

Julia Atkin
Learning by Design

Julia Atkin is an independent education and learning consultant who works across education settings in Australia and internationally. She has a passion for learning and understanding how we learn. Julia's initial research involved developing an understanding of the thinking processes involved in deep learning and in helping learners learn how to learn. For over 30 years Julia has worked with teachers, school leaders, designers and architects across early childhood to tertiary settings to transform all facets of education from the industrial era to the knowledge era and the learning demands of the 21st century. She has been recognised as an Apple Distinguished Educator Award; a fellow of the Australian College of Educators, the Sir Harold Wyndham Medal, one of The Bulletin's Australia's Smart 100 and awards for the design of educational facilities in collaboration with Mary Featherston, Hayball and Gray Puksand.

In this paper, I have attempted to distill the essence of what I have learned over thirty plus years of working alongside teachers, learners, school leaders and, in more recent times, architects in a joint endeavour to transform learning and teaching in schools. This endeavour has set about intentionally redesigning educative processes and school facilities that were designed during the industrial era, to align all dimensions of schooling with the learning demands of a post-industrial globalised world. The aim has been to design an approach to educating that is focused on empowering students to be effective lifelong learners, who recognise their own metacognitive capacity, who have a positive disposition to, and interest in their learning, and who engage in deep learning with persistence and resilience. It is about designing schools where teaching is seen to be about ensuring learning and developing learners equipped to work collaboratively and creatively on complex, non-routine unfamiliar problems[1].

My focus in this paper is on the process of designing physical spaces to support a learning centric system and the challenges teachers face in transitioning to this from a teaching centric system. This is illustrated in Figure 1. For the current generation of teachers this involves transitioning from the model of schooling they experienced as learners to a model they are helping to create. This is challenging. It requires transforming the system they know and are generally comfortable with in its predictability. Not only is it challenging but it is also complex as the system itself is a complex ecosystem of many dimensions – physical, virtual, temporal – with impacts on the sensorial, emotional, social and intellectual worlds of diverse people.

1 In the pervasive tendency to think 'either-or' some might be quick to imagine that developing learners' capability to engage in creatively and collaboratively solving complex, non-routine unfamiliar problems means abandoning the traditional disciplines. Far from it. It means ensuring that the concepts and processes of the disciplines are learned deeply in order that disciplinary knowledge can be brought to bear collaboratively for interdisciplinary action.

For more than a decade, an aspect of my work has revolved around investigating and answering the question: *What would learning spaces look like, feel like and sound like if they were deliberately designed based on deep understandings of how we learn (at all stages of life from birth to elderhood)?* Although it has been an important corollary of this work, and critical to the successful use of newly designed learning environments, my focus has been less about examining the nature of the teachers' transition and more about how to support them in the transition. I am grateful for this opportunity to 'join the dots' between why some teachers with whom I've worked have readily made the transition to innovative learning environments and why some have found it far more challenging.

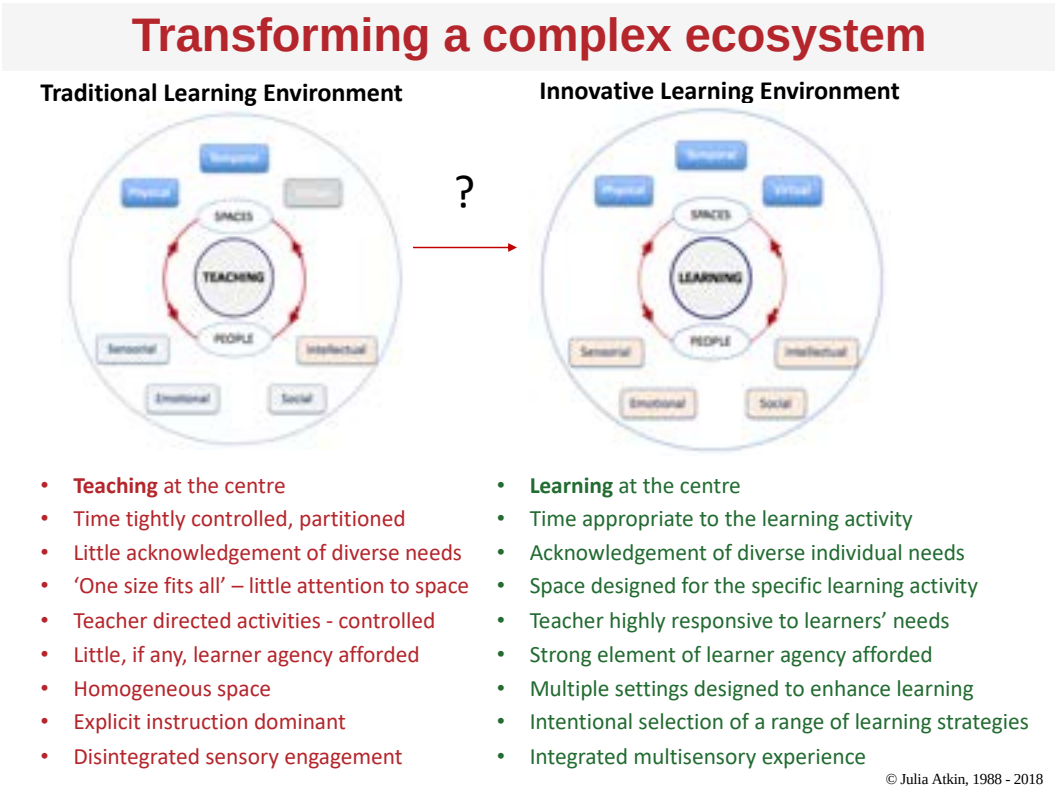

Figure 1. Transforming a complex ecosystem from a teaching centric system to a learning centric system. (Source: Author, 1988-2018).

Factors that mediate a successful transition

Making a successful transition from an homogeneous space, designed for 'one to many' teaching, to settings and spaces designed to support a range of learning and teaching activities will depend on many factors such as professional support, encouragement to take risks and a collaborative culture. Central to a teacher's success in navigating the transition will be whether they have a wide repertoire of pedagogical strategies to operate in a multidimensional environment. This in turn has been shown to depend on how they perceive their role.

Between 2000 – 2013 the South Australian Department for Education drew together the research and voices of teachers and world experts to generate a pedagogical framework, the SA Teaching for Effective Learning (TfEL) Framework (Figure 2). The research focused on unlocking what it is that teachers do to enhance both academic achievement and empower students to become lifelong learners. The SA TfEL Framework is a learner and learning-centred framework. At the time of launching the TfEL framework research was undertaken to determine the baseline position of teachers' pedagogical repertoire against the framework. Research was also

undertaken to determine what factors influenced the extent of a teacher's pedagogical repertoire. It was shown that a teacher's pedagogical repertoire was not dependent on age, gender or years of experience. The research (see Figure 3) showed **that teachers' beliefs and assumptions about their role shape their practice and strongly influence the range of pedagogical strategies they employ** (Government of South Australia, Department of Education and Children's Services, 2010).

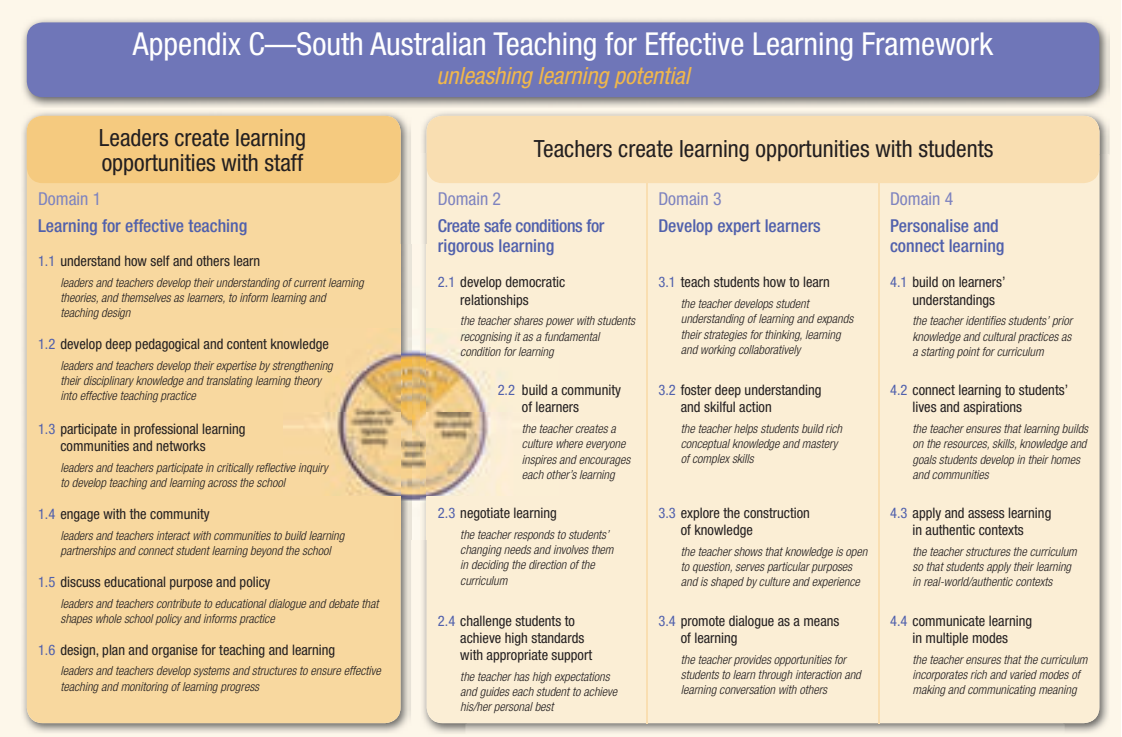

Figure 2. South Australian Teaching for Effective Learning pedagogy framework. (Source: Government of South Australia, Department of Education and Children's Services, 2010, p. 84).

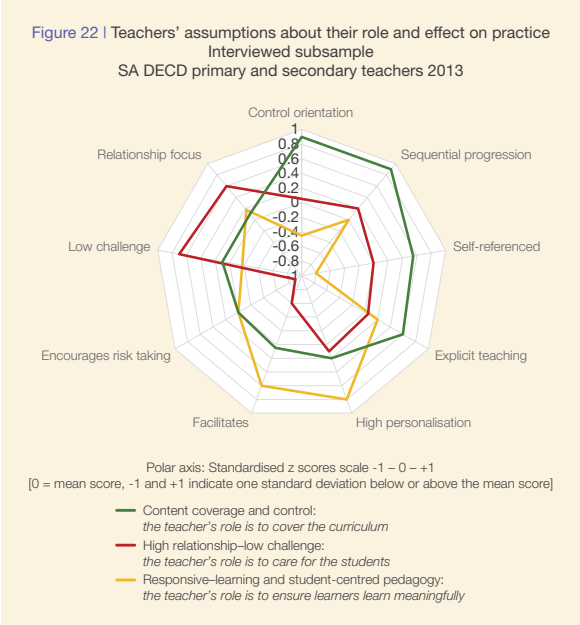

Figure 3. The impact of teachers' beliefs and assumptions about their role and the effect on practice.

The research revealed three identifiable trends in the teachers' perceptions of their role:

- **Content coverage and control** – the teacher's role is to 'cover' the curriculum; to teach the curriculum. They generally do not explicitly perceive that it is their role to ensure that learners learn what is intended in the curriculum.
- **High relationship – low challenge** – the teacher's role is to primarily care for the learners. These teachers erred on the side of not challenging learners as they perceive learners have enough to deal with as it is.
- **Responsive** – the teacher's role is to ensure learners learn meaningfully and thus the pedagogical approach was learning and learners centred. Teachers with a wide repertoire of strategies fell into this category.

A very small percentage of teachers, those classified above as 'Responsive', demonstrated that they employed a wide range of strategies that enact the 12 principles of the three domains of pedagogical practice – *Create safe conditions for rigorous learning*, *Develop expert learners* and *Personalise and connect learning*.

Further investigation of teachers' epistemic awareness and the impact of this on their pedagogical approach (see Figure 4) showed that teachers who were classified above as 'Responsive', and had a design approach to teaching and learning, reflected on their practice and their own assumptions, questioned their beliefs and viewed learning as meaning-making. On the other hand, teachers who were classified above as 'Content coverage and control' had a script approach to teaching and learning, reflected on their practice but not their assumptions, do not question their own beliefs and viewed learning as the acquisition of information with a lower emphasis on learning as meaning-making (Government of South Australia, Department of Education and Children's Services, 2010) (Figure 4).

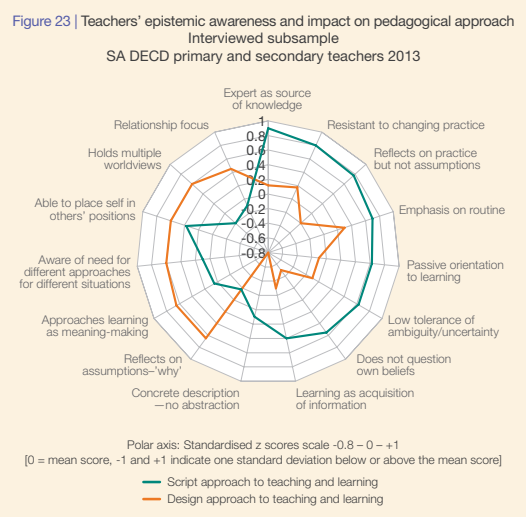

Figure 4. The impact of teachers' epistemic awareness on their pedagogical approach.

While providing obvious insight as to why some teachers will navigate the transition from a traditional learning environment to an innovative learning environment more readily than others, it also points the way to processes that will aid the transition.

Stimulating dialogue about the nature of learning, accessing teachers' own personal story knowledge of powerful, deep learning experiences, eliciting teachers' values and beliefs about learning (increasing epistemic awareness) and intentional design of settings and spaces to support different types of learning activities are all strategies that support teachers to make the transition from a traditional, teaching centric learning environment to an innovative learning environment.

Shifting mindsets through stories and analogical, metaphorical thinking

Analogies and metaphors have the power to support mindset shifts, to change perspective and develop new understanding. The word 'metaphor' is from the Greek *metapherein* – to transfer. It has roots in the Greek *pherein*, meaning 'to carry', and *meta*, meaning 'beyond' or 'over'. Metaphors carry meaning.

Over the past twenty years I have consistently asked groups of young people and adults from many walks of life - educators, parents, business people – what they mean by the term learning. I ask them to describe it in words and I also ask them to think of an image, an analogym or a metaphor for learning. Before you read on, take a moment to think of you own analogy for learning. What is learning like?

Through my informal research I've gathered responses from well over 200,000 people. As the analogies and images emerged from many thousands of people in a variety of contexts, a clear pattern emerged – there were seven recurring analogies. The seven dominant images and analogies that emerge are:

- Journey – open ended, unpredictable – not a '*trip from A to B*'.
- Growth – holistic growth – *not a linear accretion process.*
- Construction/reconstruction – creation/recreation – *not building to a blueprint.*
- Transformation – knowing and operating in the world is transformed – *not information quickly forgotten.*
- Enlightenment – deeper understanding and insight – *not recounting someone else's knowing*
- Empowerment – able to do something new and a resulting positive sense of self
- Enrichment – feel more fully human

The analogies and images are 'organic' and dynamic. The images are not linear nor are they mechanistic. Despite the fact that we 'know' the nature of learning to be dynamic, non-linear and holistic, many of the 'powers that be' persist in developing and promoting educational approaches that are based on root metaphors that are linear, rational and mechanistic. Table 1 compares what quality control looks like in the mechanistic worldview of learning versus the 'organic,' dynamic systems worldview of learning.

Table 1: Worldview of learning.

Quality control from a mechanistic, industrialised, mass production perspective	**Quality control from an organic, dynamic, growth perspective**
Uniformity sameness	Variety
Conformity	Diversity
No waste	Individuality/uniqueness
Efficiency	Matching conditions to particular needs
Culling	Beauty
How is success measured?	**How is success measured?**
Quantity produced	Quality
Uniform standards	Wellbeing & health
Minimum $ costs	Acknowledgement of individual growth against standards

In contrast to the mechanistic perspective, the organic, dynamic perspective re-imagines education from the perspective of the whole person in whom mind and matter, body and soul, head and heart are intimately connected and integrated not separate.

Of course, there are educators who have always had an organic, dynamic perspective on human learning and taught accordingly. However, if the SA research is at all representative of educators more generally, then engaging teachers in dialogue about the analogies they thought of and, subsequently, to explore a series of questions using the analogies as the basis for exploring the role of the teacher, can be enormously powerful in opening teachers up to examine their own beliefs and assumptions about their role. For example, asking teachers to consider that if learning is like a 'journey', what is their role as teacher, has led many to reject being the 'bus' or the 'bus driver' and to adopt being the 'travelling tour guide'? Once they adopt that metaphorical role, they use it to reference their behaviour. '*If I were a travelling tour guide, how would I respond?*' This reflective thought process can break habitual patterns of behaviour and encourage a more intentional approach.

Designing from the inside out

Another process that has been found to play an educative role in transitioning to innovative learning environments is designing from the inside out. Designing from the inside out resists the 'shining object' syndrome; it resists the tendency to uncritically adopt a space, a plan or an approach that has been seen elsewhere – an approach that rarely, if ever, leads to sustainable change.

An approach that does result in sustainable change and ensures any development, whether it be an innovative learning environment or a new teaching strategy, is derived from a clearly articulated set of values and beliefs about learning; from values and beliefs that stand up to the scrutiny of the latest research from the Learning Sciences. Shared values and beliefs are the touchstone and reference point for design, evaluation and innovation (Figure 5). Such an approach engages teachers who are less inclined to examine their beliefs and assumptions about learning in a non-threatening process.

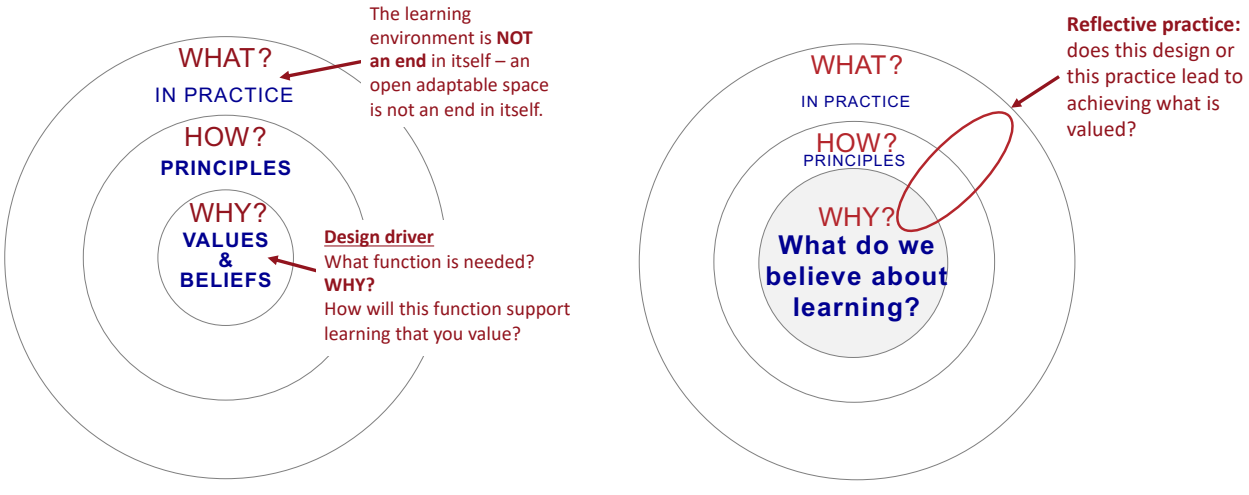

Figure 5. From values and beliefs to principles and practice. (Source: Atkin, 1996).

As shown from the SA research, teachers who exhibit the greatest script orientation to their work are more resistant to change, do not reflect on assumptions underpinning their practice, do not question their own beliefs nor question 'why'. The fact that they don't do these things does not mean they can't. Engaging these

teachers in non-threatening processes to surface their beliefs and examine their assumptions is an important strategy to help them transition from being reliant on control and from relying on explicit teaching as their dominant pedagogical approach.

Engaging teachers in identifying all the different learning activities they wish to provide for their learners, and engaging learners in identifying aspects of the environment that support their learning, then asking them to design learning settings, helps teachers, and learners, think afresh about how the design of the physical space could be used to enhance learning (For an example see the Association for Learning Environments' learning furniture resource). The very process of doing this helps them more readily imagine what it might take for them as teachers and learners to operate effectively in the innovative learning environments they design. An additional, really effective strategy is to design a prototype environment that learners and teachers can experiment in and learn their way into operating effectively.

Key factors for successfully transforming the complex ecosystem

Essentially the key factors involve setting up the situation so that there is:

- commitment to a **strong, clear, shared vision** – *authentic process to co-create a shared vision*
- **design of purposeful spaces to enhance learning** in all forms
- **collaboration and co-design** – *architects, educators, learners, community, planners*
- **responsiveness** – s*chool leadership, teachers, learners, bureaucracy*
- **prototyping, evaluating, implementing, evaluating** – *learning our way forward*
- **school-based design & development team** – *supported by time allowance and facilitation*

In the Steven Spielberg film, 'Lincoln', there is a powerful scene in which Abraham Lincoln and the radical Republican Leader Thaddeus Stevens are talking. Thaddeus Stevens is pronouncing on the human race losing its way - losing its way in relation to the inner moral compass that ensured justice. Lincoln sat back and said that in his early days as a surveyor he had learned that a compass was a powerful instrument for finding true north but it didn't alert you to the swamps and pitfalls you would meet on the way. He went on to add if you don't avoid the swamps, what's the point of knowing true north?

Whether the discussion can actually be attributed to Lincoln is another matter. What it served to illustrate was that Lincoln was a superb strategist. Identifying and articulating values and beliefs about learning and identifying key factors for successfully transforming from a teaching centric to a learning centric ecosystem can help point the way, can help us find 'true north' but the compass bearings alone will not alert you to the all the lived realities of the process. Through their telling of multiple stories of transition, the research papers that make up this volume will help alert you to the swamps, pitfalls as well as the high ground. This is the power of the ILETC project.

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Keynote address - Phoenix

Do you see what I see?

Philip Idle
EIW Architects and Association for Learning Environments | Australia

Philip is an architect with over 30 years experience in the briefing, planning, design and delivery of education projects in Australia, and more recently in Tanzania and China. His work encompasses both the private and government sectors in Australia and has extended to service work in Tanzania and the International School sector in China. With expertise in the design and planning of educational facilities, Philip leads the consultation phases of projects that has led to him developing great empathy for learners and teachers resulting in designing contemporary and innovative learning environments. An original Australasian member of the Association for Learning Environments (formerly CEFPI), Philip will take up the position of Chair of the International Board in November, 2018. Philip has encouraged the leadership to develop a more comprehensive way of viewing cultural and geographic differences as potential opportunities for sharing knowledge and developing quality learning environments for learners and teachers alike.

'Study nature, love nature, stay close to nature. It will never fail you'.

- Frank Lloyd Wright

As a young architecture student, I fell in love with the rich history of the built environment, of architects who dared to dream, who created and articulated space, who challenged societal norms and developed new ways of seeing. Frank Lloyd Wright was one of those special architects who captured my imagination, who made me consider more strongly our place in the world and within the environment. Through his architecture, he developed a fluidity of space and embraced the harmonic expression of the human scale. His celebration of materials, of textures and structure, of his articulation of space with furniture around the edges, produced spaces with a soul. His designs blurred the edges of enclosure, flooding spaces with light and importantly a strong connection to nature. Here was an architect who understood the human condition, the way we hear, move and feel. He was sensitive to acoustics, sightlines, a warmth of spirit and a creativity of the mind.

In a similar way Norwegian architect, Christian Norberg-Schulz, spoke about the 'genius loci', the spirit of place (1980). Derived from Roman times and the belief in gods inhabiting certain places, the definition has evolved to mean for us 'the unique, distinctive and cherished aspects of a place.' He too argued that how we perceive spaces is grounded in nature, an understanding that drives intuitive responses as humans.

We are -

- 'A thing among things' – being of nature.
- 'We use nature' – we use, adapt, consume, create from and often abuse.
- The sun and directions of the compass ground us in nature.
- It feeds our understanding of things - we have evolutionary developed ways of seeing rooted in nature.

- We interact and experience the environment as meaningful – we know our place, even when ignoring our responsibilities.
- We live with light and are attuned by light.
- The rhythms of day and night drive our sense of time within the place.

As human beings, we have evolved with an acute awareness of our affinity with nature, acknowledging that the built environment - that which comes out of the natural environment - affects the way we think, feel, how we act and what we do. The currency of principles of biophilic design resonate with us as we seek to engage more with the natural environment through our experience with the design of the built environment.

During 1990, on my first major travels internationally, I purchased *'Places of the Soul: Architecture and Environmental Design as a Healing Art'* by Christopher Day (1990), a Welsh architect and sculptor. This was a book which revealed to me the sensory nature of design and different ways of seeing and experiencing, both consciously and subconsciously, the places we create.

Day (1990) listed a number of elements in advocating for the responsibilities of architecture. These included –

- To minimise pollution and ecological damage
- To minimise biological effects to the occupants
- To be sensitive to the surroundings
- To act harmoniously with the surroundings
- To show responsibility to the human individualities who will come into contact with the building

He speaks of "responsibilities not only in the visual aesthetic sphere and through the outer senses but also to the intangible but perceptible 'spirit of place'" (Day, 1990, p.16).

I asked myself, 'Do I see what he sees?'

Understanding how we as humans perceive a space and transform it into a place involves our cognitive processes, a three-way collaboration between mind, body and our environment (Goldhagen 2017). How we understand and interpret a space we walk into depends on the lens through which we view it. The impact of our 'sensory, social and internally generated data' (Goldhagen 2017, p.46) that provides a lens through which we see things is a very personal response to our built environment.

Goldhagen's (2017) reference to embodied metaphors – things that suggest, reinforce and captivate an action sequence from us that is both cognitive and non-cognitive in response –

- Natural landscapes settle a person's heart rate
- Bright lights stimulate creativity and bright ideas
- Closed spaces offer refuge and safety
- Expansive spaces invite exploration
- Colours can heighten and dampen emotions
- Curving surfaces suggest approach
- Straight edge surfaces suggest retreat – the idea of 'backs to the wall'

Focusing on all our senses, of our place and interaction with the natural world, which includes people, feeds the soul.

We often look at learning environments in photos and they are yelling at people - 'I am an innovative learning environment!!!' People think 'wow there must be great things going on in here, it just looks that way!' The challenge is to move beyond these superficial representations and engage in deeper learning and understanding the what, why and how of innovative learning environments. We should be seeking out a design depth, one that empowers relationships, that provides meaningful affordances for having dialogue, of resonating with the human spirit of life itself. We are not exclusive of the natural environment in the same way as we must not be isolated from the built environment. We have to move on from thinking that the visual representation of an environment, whether that be from a photograph or video, is accurately expressing the nature of things.

In a similar fashion, leadership of schools and colleges who talk the talk need to show they walk the walk. Rebadging standard classrooms into 'learning studios' or similar can result in a very 'shallow expression of practice' (Bolstadet al., 2012) that does not necessarily support more future oriented teaching and learning practices.

So is it about the shape and form? Is it about the affordances, the furniture? Is it about the teachers and students? Or do we define the learning environment by the synergy between all three? Can you have one without the other? Can you have any in isolation?

The concept of 'dynamic learning' (Leadbeater, 2016) challenges the jargonistic use of words such as 'collaboration', 'individualised', 'personalised', 'project based' – all valid terms of transitioning between older dichotomies to current practice, but possibly having served their purpose. Dynamic learning experiences begin to encompass all of these traits wholly or in parts. But as we experience space and respond to the cognitive clues we are confronted with, so we also see the activities and practices involved as learners as being far more dynamic than being classified.

Transitions18 provided this depth of knowledge sharing in the midst of trying to understand more how we see and use innovative learning environments, how we identify effective teaching practices within these spaces, and how we begin to develop deeper learning experiences.

'Form follows function - that has been misunderstood. Form and function should be one, joined in a spiritual union.' Frank Lloyd Wright

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Innovative educational environments: Are the strategies developed by teachers working?

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Abstract

This paper focuses on educational activities currently developed in Innovative Educational Environments (IEEs), with the aim of verifying if the strategies developed in these spaces have impact on students' learning outcomes (SLOs). Data were collected through: i) video recording of the classes in action developed in the IEEs of three Portuguese public schools; and ii) the SLOs. The instrument selected to analyze the activities developed in the IEE's was the Linking Pedagogy, Technology and Space observational metric (Byers, 2017). The results obtained showed the influence of the space in the adoption of diversified pedagogical dynamics. In its turn, the analysis of the SLOs revealed that the teaching strategies developed in the IEE's enhance the learning process. These results contribute to highlighting the potentialities that such spaces may represent in the change of pedagogical strategies and learning activities adopted in today's classrooms.

Keywords

EDUCATIONAL ACTIVITIES | INNOVATIVE EDUCATIONAL ENVIRONMENTS | CLASSROOM SPACE | LEARNING OUTCOMES | STUDENTS | TEACHERS

Introduction

Classrooms as learning spaces are part of an expanding research field in the educational context. It seems particularly important to understand which type of role the physical classroom space plays in the teaching-learning process, and the kind of strategies that can be used for improving students' success. Based on empirical evidence (Ariani & Mirdad, 2016; Granito & Santana, 2016) physical learning spaces have been found to influence student performance.

The OECD (2017) updated its definition of an "innovative learning environment" (ILE), defining the term as:

> *"an organic whole embracing the experience of organised learning for given groups of learners around a single 'pedagogical core'; (…) larger than particular classes or programmes; includes the activity and outcomes of learning, rather than being just a location where learning takes place; (…) optimise learning for its participants" (p. 16).*

In the past years, many schools have been moving towards the implementation of ILEs. To accommodate this transition, flexible learning spaces have been built with multiple zones for supporting individual and group-based teaching and learning practices (Wall, 2016).

Several studies conclude that the quality of the physical environment significantly affects student behavior and achievement, contributing to enhanced creativity, interactivity, communication between students and teachers, as well as to create more effective group work (Earthman, 2004; Neill & Etheridge, 2008; Tanner, 2009; Wall, 2016; Wilson & Randall, 2012; Woolner, Hall, Higgins, McCaughey & Wall, 2007).

According to Oblinger (2006), the change in learning spaces tends to trigger changes in practices, which often reflect on the behavior of the people who work in those spaces and the pedagogical approaches that are adopted inside them. Consequently, it is inadequate to think that today's learning can succeed in classrooms that were built in the middle of the last century, when what was socially and commonly expected from school was extremely different from what is expected now (Pedro & Baeta, 2017).

In recent years, initiatives have flourished at an international level, such as Modern Classrooms (Leahy, 2016), Future Classrooms (European Schoolnet, 2017) or Innovative Educational Environments (ERTE, 2017), with innovative visions for how today's classrooms should be. Even though it is difficult to find a consensual definition of these concepts, it is considered that these are not confined to the idea of different organization of the physical space of the classroom, but tend to be characterized as learning laboratories, equipped with different technology and materials where pedagogical dynamics are also rethought.

NEW LEARNING SPACES: A CATALYST FOR CHANGE?

Blackmore, Bateman, Loughlin, O'Mara and Aranda (2011) identified the following indicators as strongly associated with learning outcomes:

- Attainment (measured by standardised test scores and teacher observations);
- Pedagogical effects (engagement in learning);
- Social (quality of student/teacher and student/student interactions; student interpersonal competencies; team work);
- Affective (sense of belonging and inclusion, self-esteem, self-confidence);
- Wellbeing (physical comfort, health, sense of safety);
- Behavioural changes (retention, suspensions, violence, disruption in class).

The authors also recognised that the connection between learning outcomes and built environment was mediated by the use of the learning spaces which were related to tangible variables (air quality, light, spatial density), as well as intangible variables (school/classroom culture, students' sense of belonging and self-efficacy). Studies developed by Barrett, Zhang, Davies and Barrett (2015) revealed that the factors underlying the design of classroom space (air quality, lighting, noise, temperature), when well designed, have a positive effect on students' academic achievement and increase school retention. Despite all these studies, it is important to find some empirical evidence to measure the effects/influence of space on teachers' pedagogies and behaviours, and of these on students' learning outcomes (Brooks, 2011) when new types of classroom spaces are put into use (Blackmore et al., 2011).

'INNOVATIVE EDUCATIONAL ENVIRONMENTS' IN PORTUGAL

Following the Future Classroom Lab (2012) initiative (European Schoolnet, 2017), in the Portuguese educational context, 'Future Classrooms' have been created. Presented as 'Innovative Educational Environments' (IEEs), with a reconfigurable and multifunctional structure, these spaces are intended to be incubators of new classroom dynamics, through the promotion of active learning methodologies and the innovative use of digital technologies. According to the Ministry of Education (ERTE, 2017), there are presently 44 IEEs in Portuguese primary and secondary schools. Due to the proliferation of these new educational spaces in the national context, it is important to focus the study on this phenomenon, given the lack of empirical support for the work developed inside them and the impact on student learning outcomes (SLOs).

Methodology

This is a descriptive study that follows a quantitative methodological approach. The data collection took place between March and June 2017, and pedagogical dynamics and the teaching strategies were analyzed in these spaces, as well as the impact on SLOs.

PARTICIPANTS

The participants were teachers and students who participated in the nine classes dynamized in the IEEs of three public schools (School A, B & C). The study involved: i) 9 teachers, 7 female and 2 male, belonging to different curricular areas (Physics and Chemistry, English, ICT, Portuguese, Mathematics); ii) 163 students, 92 female and 71 male, from different classes (7th , 8th and 9th grade).

INSTRUMENT

To analyse the collected data, the observation metric Linking Pedagogy, Technology and Space (LPTS) was applied. This measurement system provides real-time empirical evidence of spatial interventions by teachers through their practices and subsequent impact on students (Byers, 2017). Structured around five domains and 36 indicators, the design of the metric records the time spent in each activity and associated behaviours as they occur. The percentage values associated with each indicator represent their duration throughout the class (from the moment that certain activity/behaviour starts until it ends), which allows for the occurrence of different types of activities simultaneously developed by the teacher and the students.

PROCEDURES FOR COLLECTING AND ANALYZING DATA

Requirements were defined to collect the following data in each of the selected spaces and at every recording session:

- Obtaining parental authorization for each student, prior to the data collection;
- Prior access to the lesson plans provided by the teachers related to each class;
- Access to SLOs (grades of the products developed; online tests/quizzes provided).

Considering the layout of the IEEs (Figure 1.), four video cameras were used to guarantee full coverage of the area. Placed in the corners of the rooms and assuming different focuses, three of the cameras were totally fixed, while the fourth, movable by the researcher, was used to record specific actions of the teachers and the students.



Figure 1. Position of the cameras in the IEEs.
(Source: Authors, 2018).

Regarding the application of the LPTS metric, in this study we focused only on the results related to the domain 'Pedagogies', constituted by the following indicators:

- Didactic Instruction- when the teacher is engaged in presenting/disseminating content, concepts or information to students through a direct instruction mode;

- Interactive Instruction- when the teacher is engaged in demonstrating an ability and/or explaining concepts or processes associated with curriculum content through an interactive instruction mode (using technological equipment/tools);
- Facilitating- when the teacher is moving around the room to manage/monitor students' progress and behaviors;
- Providing Feedback - when the teacher provides feedback (advice, direction or suggestions) on the progress made on students' work;
- Class Discussion- when the teacher promotes student interaction and discussion within the class;
- Questioning- when the teacher questions the student(s) about certain curricular contents.

Results

Despite the differences in the pedagogical dynamics established in the IEEs, most of the SLOs present positive values, higher than 60%, except for Class 1 of School C, whose value obtained was lower, with 53,97% (*Table 1.*).

SCHOOL A

In School A, the average of SLOs is higher than 60%. From the results obtained, Class 2 stands out with an average of 87,50%. In this class it was verified the adoption of a more interactive instruction, with 53% of class activity involving dynamic and less expositive and /or self-centred performance with the teacher dynamizing the class, partly with the use of technological resources. In addition, the teacher frequently spent some time questioning (18%) students about thematic content and tasks. It was verified that there was an increase in the facilitation process (43%), with the teacher guiding and observing students' behaviors and their engagement in practical activities, simultaneously providing feedback (31%) about the content and work developed. About the class discussion, the 89% registered indicates that the interactions between teacher and students and among the students were a priority, occurring in a constant way throughout the entire class.

At the opposite pole, Class 3 was the one with the lowest results on SLOs, 60,33% (relative to Classes 1 and 2). In a 9th grade class, the teacher adopted a didactic, expository and teacher-centred instruction (20%). In this context, the lower value (2%) stands out for the questioning process, however, the facilitation process and feedback provided had values above 60%. Despite the promotion of interactions established in the classroom, the value obtained, 76%, was the lowest. In Class 1, with an average of 71,96%, it was verified that in a substantial part of the class dynamic (70%), the teacher spent part of it in activities monitoring and facilitating the students' learning process, essentially during practical activities, promoting class discussion (82%).

SCHOOL B

In School B, Class 2 had the best results in SLOs, registering an average of 78,95%. In this class, the teacher adopted a more didactic mode of instruction (30%) and less interactive (22%). Class discussion happened constantly (72%). Although it was the class with a better average on SLOs, Class 1 had more balanced pedagogical dynamics results. With an average of 75,03%, in this class the values were greater than 80%, namely for the facilitation process (85%), providing feedback (84%) and class discussion (87%), indicating that the teacher privileged practical activities, investing in monitoring of students' activities, and providing feedback about the tasks. Such activities increased the interactions in the classroom, in which students had the opportunity to discuss among themselves and with the teacher the class thematic contents. Despite the lower average obtained in SLOs, 64,56% (relative to other classes), Class 3 was the one with highest values in the adoption of a didactic instruction mode (35%). For class discussion, there is a similarity in the value from Class 2 (72%).

SCHOOL C

In School C, Class 2 got an average of 73% in SLOs. In this class, there was a low level (and even absence) of instruction modes, with 1% (Didactic Instruction) and 0% (Interactive Instruction). Despite the absence of active instruction by the teacher, there was a constant questioning process, 42%. The presentation of the work developed during the practical activity allowed the teacher to regularly monitor the students (90%), and the fostering of interactions established in the classroom (99%). In Class 1, the lowest average of SLOs corresponded to 53,97%. In this class the establishment of more didactic modes of instruction (12%), as well as activities of monitoring (72%) and providing feedback to students (56%) has been verified, especially during the practical activity. In Class 1, the promotion of class discussion stands out (89%).

Conclusions

The analysis of the quantitative data revealed positive values in students' academic achievement with all average values higher that 50%. The didactic instruction indicator showed a higher prevalence in Classes 2 and 3 of School B and Class 3 of School A, with values ranging from 20 to 35%. In these classes, the management of the activities by the teachers was mainly focused on themselves, with the same applying to the presentation of the curricular content/tasks. Often, teachers exposed content using interactive boards to explain them to the students, who in turn tended to assume a passive attitude, visually following the explanations provided.

The adoption of more interactive and dynamic modes of instruction was verified in Class 2 for both School A (53%) and School B (22%). In these classes, teachers adopted more student-centred activity dynamics. Contrastingly, Class 2 from School C, shows the absence of this mode of instruction. The same percentage value (3%) was, interestingly, obtained in three classes from different schools.

It can be observed that the best SLOs obtained in the classes recorded were the ones with pedagogical strategies associated with the facilitation process, in which the teachers spent a substantial part of the classes monitoring students' learning process, and with the students focusing on the execution of the tasks required. However, this type of pedagogical dynamic was less frequent in Class 2 of School B.

Following this process, the activities related to providing feedback stand out. This pedagogical dynamic appears to be associated with activities that allow the teacher to provide suggestions, advice and qualitative assessments regarding the students' work. In this indicator, the best average obtained in the SLOs was achieved in Class 1 of School B.

The class discussion indicator showed a high representation among all classes dynamized in the IEEs, registering the lowest value of 72% in Classes 2 and 3 of School B and the highest value, 99%, in Class 2 of School C. In those classes, particular attention was given to encouraging teacher-student and student-student discussion. With exception of Classes 2 and 3 of School B, the remaining classes are the most representative in this indicator and those presenting the best SLOs. About the questioning process, the indicator obtained a higher representation in the classes whose SLOs are superior, which indicated that this process became fundamental for the teacher to verify the apprehension of the curricular contents by the students, considering that the most part of the questions related to thematic contents.

In all classes, it was possible to verify that they share in common the achievement of favourable results and the promotion of high levels of interactions in the classroom. Accordingly, it is possible to claim that one of the successful strategies to improve the teaching and learning process and SLOs, is the creation of interactions in the classroom, stimulating the sharing of ideas about different curricular contents.

Acknowledgements

This work is being financially supported by the Fundação para a Ciência e Tecnologia, I. P. – Portugal, under the scope of the Project Technology Enhanced Learning @ Future Teacher Education Lab (contract PTDC/MHC-CED/0588/2014) and the PhD Program 'Technology Enhanced Learning and Societal Challenges' (contract PD/BD/135198/2017).

The authors wish to thank all the participants of the three schools and express their deepest gratitude to Dr. Terry Byers for the availability and support for this work.

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Negotiating learning spaces design in Irish post-primary schools

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Abstract

In Ireland, post-primary school classroom layouts have recently been reviewed by the Department of Education and Skills (DES) in the context of ongoing curriculum reform. The DES Technical Guidance documentation outlines how school design will be responsive to intellectual, creative, physical and social activity and inclusion needs. It will be a school building that the students will make their own while providing a stimulus for the school's curricular and extra-curricular activities. The Design Team's primary aim must be to provide the quality and character of environment appropriate to the educational aims, philosophy and the ethos of the school to the ethos of the school and involve stakeholders in the building design process as an educational endeavour. However, there is little evidence to suggest that the DES Technical Guidance are being activated from policy into practice. This research aims to analyse the policy environment and the work of schools who have recently engaged in learning space design within DES-funded building projects to identify current practical affordances and barriers and secondly to apply these findings through 'Negotiated Learning Space Design (NLSD)' with two case study schools about to embark on the design of learning spaces in new post-primary school buildings.

Keywords

NEGOTIATION | JUNIOR CYCLE REFORM | VOICE | CURRICULUM | CHANGE | CASE STUDY

Exploring the affordances and barriers to learning space design in Irish Post-Primary schools

The Department of Education and Skills (DES) in Ireland has outlined an ambition to ensure that children are being educated in modern, state of the art facilities that are fit for purpose and meet the needs of the curriculum reform (DES, 2017). The junior cycle curriculum reform (12 – 15 years) began in 2014 on a phased basis. The *Framework for Junior Cycle* (Department of Education and Skills, 2015) incorporates a shared understanding of how teaching, learning, assessment and reporting practices should evolve to support the delivery of a quality, inclusive and relevant education that will meet the needs of junior cycle students, both now and in the future. This shared understanding was informed by engagement with stakeholders and by national and international research. The Junior Cycle Framework which 'places the student at the centre of the learning process and envisages a modernised curriculum across all subjects. It allows for new ways of learning and a broader range of skills to be properly assessed' (p. 4).

Current Policy

The DES are transparent in the communication of the building policies which provide guidance for school authorities, and their design teams, who are involved in providing new or additional educational accommodation. The DES has an ongoing policy of updating and improving its Technical Guidance

Documents (TGDs) (Department of Education and Skills, 2008, 2017b, 2019) for post primary schools with a view to offering better guidance to all. The policy documents detail the design and technical guidance together with the procedures which must be followed where funding is being made available from the DES.

The senior cycle curriculum is currently undergoing a review process lead by the National Council for Curriculum and Assessment (NCCA). The DES will be investing €8.4 billion in school building projects from 2019 to 2040 (Department of Education and Skills, 2018). Project Ireland 2040 is the Government's overarching policy initiative to make Ireland a better country for all of us, a country that reflects the best of who we are and what we aspire to be. This reflects an increase in the school building budget of 70%. This research will examine the lived experiences of all stakeholders (Principals, teachers, students, parents, civil servants, architects and engineers) in Irish post-primary schools when the Building and Planning policies are enacted to design learning spaces in new post-primary schools.

The ethos of the Educate Together Second Level schools also outlines a vision for the built environment to support the best learning environment,

> *In providing the best possible learning environment for young people an Educate Together school community must consider how the architecture, layout, décor and facilities of a school play a vital role in shaping the learning environment and how they influence students' academic performance and well-being in school.*
>
> - (Educate Together, 2009, p. 37)

However, in reality the lived experience of these technical building, curricular and ethical policies must be problematised. It is important to investigate the affordances and barriers provided by these policy documents to ensure the highest quality learning experiences and outcomes, accountability to the Irish tax payer and that the learning spaces we are building are environmental cues to support the implementation of curricular reform.

This is an authentic opportunity to conduct meaningful research on the negotiation of learning space design in this context. The findings will contribute to and enhance the work of Project Ireland 2040 ensuring that school buildings are created which are 'fit for purpose and meeting the needs of the curriculum reform' (www.education.ie).

Methodology

This research will contribute to a conceptual framework for capturing and structuring the main physical characteristics of school design that are supportive to learning in Junior Cycle in Irish post-primary school. For the purposes of this research, school design is defined as the spaces in the school which are available for learning, their internal layout and how they relate to each other act as a cue for student centered learning through a learning outcomes-based curriculum. This research aims to involve Principals, teachers and students in the participatory design of the learning space. The study consists of iterations, with each iteration considered a cycle leading to development of the conceptual framework. The research is tracking the perceptions of all stakeholders at both case study sites.

The methodology is designed in light of the vision for enacting the Junior Cycle Framework 2015 through negotiating and creating environmental cues in classrooms, building relationships with all stakeholders and promoting a culture of active learning and collaboration through a democratic participation. It is important to have an awareness of uncovering assumptions, biases, and perceptions of the researcher and participants in relation to learning space design in Irish post primary school buildings. This awareness is outlined in the

philosophical positioning and conceptual framework of the researcher. The DES Building and Planning Section, ten school Principals (selected via online survey of all 730 post-primary principals) who have experienced learning space design in school buildings and two green field site school principals who are currently immersed in the process of learning space design with the DES.

The primary research question is *'How do the DES Technical Guidance Documents support learning space design within school buildings, support curricular reform which places the learning process at the centre, in state funded post-primary schools in the Republic of Ireland?'*

The secondary research questions address:

- What are the past lived experiences of school leaders, teachers, students and the DES building unit of the enactment for learning space design in green field site schools, renovations or school extensions?
- How might we negotiate learning space design through the current medium of the generic room layout model?
- What are the current lived experiences of school leaders, teachers, students, parents and the DES building unit of policy enactment for learning space design in green field site post-primary schools?

Research Sites

School A was founded in 2015. It has occupied three different temporary buildings. The DES appointed a team of architects to all school projects. The architects must follow the DES Technical Design Guidelines and design the school using the generic room layouts. The Principal and Board of Management have participated in a meeting with the researcher to discuss the proposed plans in light of the ethos of the school. A rationale for this research is that there is no published research available in the Irish context to indicate the extent to which learning space design is negotiated with stakeholders during the school building process. The researcher will support the Principal in negotiating the learning space design with the teachers, parents and students through the Appreciative Enquiry Design model: Discover, Dream, Design, and Deliver.

A pilot workshop, conducted in May 2018, was to enact the philosophy of the school in the learning space design from the beginning. This means that student voice, democracy and strong relationships are core to a fun and friendly learning environment where everyone can grow and learn. The parents and students asked 'what will our new building look like?' There was an assumption that they would not be involved in the process of designing the building. This research aims to change that through the negotiation of the school layout and design to optimise learning. The perceptions of the parents and students in relation to the learning spaces were associated with a product (e.g. grades, getting a good job) rather than by the educational experience as a 'learning journey' (DES, 2015). The students also perceived learning as a teacher at the front with the desks and chairs in rows. It would be a challenge for students to negotiate and imagine new spaces and ways of learning when the primary system has already inculcated certain "ritualised routines" (Nuthall, 2005), assumptions and expectations among students. For this reason, second year students, who have experienced the first year of the new junior cycle will participate in the research. This will provide authentic student voice relevant of the new junior cycle. The routines established in primary school and the impact of this on their perceptions of post-primary education are not within the remit of this study. The school opened in September 2018. The students and teachers have participated in innovate learning and active learning methodologies. The teachers have used a variety of furniture to create flexible learning spaces in the temporary building. The students participate in project and group learning as part of day to day teaching and learning.

School B has occupied a temporary building for two years. The students and teachers have participated in innovate learning and active learning methodologies to implement the *Framework for Junior Cycle* (DES, 2015). The teachers have rearranged and experimented with a variety of furniture to create flexible learning spaces in a temporary building. The students participate in project and group learning on a daily basis. The DES design team for School B worked through phases one to four with no input from teachers, students or parents. There is evidence of impetus around school design from the DES (2018), however, within these architecturally designed buildings the learning spaces remain traditional. There appears to be anecdotal evidence of Principals who have a vision and persistence to pursue negotiation with the design team in relation to the layout of the learning spaces. This research aims to gather and analyse that anecdotal evidence of school leaders who have experience of the building process. The internal layout and design of the learning spaces will be negotiated with the students, parents and teachers. This is advantageous for both the research and the school as the stakeholders have been experimenting with learning culture, digital learning resources, student-centered learning and learning space layout in temporary buildings for three years. The work of the temporary school in this regard is important to note as evidence suggests that a change in learning space alone will not increase learning. A change in space supports those teachers who are able and willing to integrate different affordances into their practice (Byers 2018).

Conclusion

Introducing new curriculum and building new schools is expensive. The design of these buildings require research in order to ascertain what learning spaces work and don't work. The data collection is ongoing with structured interviews with the DES Building Unit personal and Principals with experience of the process. The emerging themes from these interviews will contribute to the Appreciative Enquiry model which is in place with the green field site schools in relation to learning space design. This information could be valuable to a range of stakeholders, including architects, engineers, school leaders, teachers and parents. The information gained through this research will negotiate the design of learning spaces within the new school building projects or assist those occupying existing facilities who wish to get the most out of what they already have. The DES Technical design guidelines reveals the complex relationship between education policy, pedagogical practices, curricular reform and the learning space design. The DES Technical Design Guidelines lack a clear political intention to introduce innovation and spark change in teaching and learning practices through changing spaces and different constraints hindered the envisaged transformation of practices in contrast to the DES curricular reform which embodies innovation and creativity as its essence.

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Linking pedagogy and space with ALINA

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Abstract

Current research literature in higher education often approaches the transition towards active learning from either a pedagogical view or from a learning space perspective. The Flanders-wide project ALINA chose a holistic approach consulting all stakeholders involved in the process of designing and using learning spaces in order to bridge the gap between pedagogy and learning spaces (Peeters & Binnard, 2018).

Quantitative and qualitative data was collected through a large survey, interviews, focus groups and pilot projects giving insights into the perspectives of students, lecturers and experts. The results describe a vicious circle that reoccurs on different levels within Flanders higher education: the lack of use of innovative teaching practices reduces the demand for collaborative rooms, which reinforces traditional habits of teachers. ALINA acts as a mediator, translator and change manager in order to break this vicious circle. Together with all stakeholders, recommendations were co-created for teachers and staff.

Furthermore, a model and proof-of-concept tool have been developed to link teaching methods and learning spaces. Another initiative is the foundation of a multidisciplinary taskforce discussing barriers to and opportunities for active learning within KU Leuven. The main result of ALINA is the contribution to a momentum of interest in innovative teaching methods and spaces.

Keywords

NEXT GENERATION CLASSROOM | ACTIVE LEARNING SPACE | INNOVATIVE LEARNING ENVIRONMENT
LINKING PEDAGOGY AND SPACE | INNOVATIVE TEACHING METHODS | CHANGE MANAGEMENT

Introduction

The growing quantity of research literature addressing innovative teaching methods in higher education proves the rising interest in active and collaborative learning. Studies show that active learning methods have a positive influence on (learning) results (Deslauriers, Schelew & Wieman, 2011; Freeman, 2014; Schmidt, 2009) and thus contribute to education quality. A similar evolution can be noticed when it comes to the physical learning environment: the amount of literature describing the benefits of Next Generation Classrooms (NGC) and Active Learning Classrooms (ALC) grew steadily during the past years (Uskov, Bakken & Pandey, 2015).

Despite the opportunities and possibilities described in literature, the scientific proof in active learning methods and active learning spaces are scarcely reflected in the educational practice within Flemish higher education. Most experiments with active learning are limited, small-scale and depend on personal initiative.

The Flanders-wide project ALINA (Active Learning IN the Association, 2015-2017) (Peeters & Binnard, 2018) consulted all stakeholders involved in the process of designing, constructing, equipping, supporting and using learning spaces as well as teaching staff, pedagogical support services and students in order to gain a better understanding of the reasons for the limited implementation of active learning in everyday teaching practices

and space management. The follow-up project STEAM-ALINA (2017-2018) was initiated within the KU Leuven Science, Engineering and Technology Group to maintain this interaction between stakeholders and further implement the results of ALINA.

ALINA and STEAM-ALINA uncovered multiple challenges in constructing, using and maintaining active learning spaces that lead to a lack of conformity between pedagogy and space. This gap between pedagogy and learning spaces results in a vicious circle that holds back the implementation of active learning methods and spaces. This paper describes the methods used to uncover the gap between pedagogy and space and the developed strategies to turn this vicious circle into a positive spiral that encourages and supports both active learning methods and next generation learning spaces.

Methodology

Stakeholders have a substantial influence on a successful change (Sucozhañay et al., 2014). In order to gain a wider understanding of the interests that influence the implementation of active learning methods and spaces, the Pedagogy-Space-Technology (PST) framework was used to identify and analyse all stakeholders involved (Radcliffe, 2009). 'People' was added by Veugelers (2017) as a fourth key element to create an overview of the different perspectives that play a role in the construction and use of active learning spaces (Figure 1).



Figure 1. Pedagogy-Space-Technology-People (PSTP) framework to design and evaluate learning spaces. Adapted from Veugelers, (2017), and Kreitzberg, (2008).

The following stakeholders were identified for each key element of the PSTP model:

- Pedagogy: Lecturers, didactic teams, study counselors and the central educational development unit
- Space: Planners, technical services, architects and experts in acoustics
- Technology: The central IT office, technical services
- People: Students, policymakers, all the above stakeholders

Quantitative data was collected through a survey of lecturers (N=845), hereby mapping the actual but also the desired teaching and learning methods and spaces used within the KU Leuven Association. In order to gather qualitative data, interviews and focus groups were done with experts in architecture, acoustics, planning, educational strategies, educational technology and learning spaces.

Within these interviews and focus groups, thresholds in and the reasoning for the existing policy and procedures were the main topics. Additionally, technical, infrastructural and other barriers were mapped through fourteen pilot projects. Most of these focused on lecturers by testing innovative teaching methods in existing traditional rooms, but also in active learning classrooms or alternative locations. ALINA deliberately chose larger groups containing 60 or more students. A significant amount (200) of these students participated in focus groups or completed a questionnaire. Other pilot projects focused on policy makers by following up existing (re)building projects.

Observations

The results of the survey, focus groups and pilot projects were as diverse as the targeted stakeholders. Nevertheless, some striking similarities can be noticed.

THE UNIVERSITY 'ECOSYSTEM' TENDS TO BE CONSERVATIVE

Since medieval times, traditional ex cathedra teaching methods in lecture halls are the main modus operandi for information transfer at universities (Park & Choi, 2014). As a result, universities are optimized in order to support traditional lectures in traditional learning spaces. Additionally, lecturers are most likely to apply the teaching method they are most familiar with. Therefore, switching to a more activating and student-centered approach, requiring coaching skills, spatial management, technical skills and knowledge of active learning methods, is often a bridge too far. Likewise, for students, active learning demands a shift from a passive/consumer attitude towards a (pro)active attitude. Moreover, planners and supporting services testified that active learning goes against the common course of events. For architects, designing Next Generation Classrooms (NGCs) is more challenging because of guidelines and legislation, which are in tune with the layout of traditional learning spaces. Because of this, active learning often demands the extra mile for a lot of stakeholders. This influences the overall experience with active learning.

THE ALTERNATIVES FOR TRADITIONAL EDUCATION SEEM EXPENSIVE AND TIME CONSUMING

From a pedagogical point of view, and as described in Lowery (2016), lecturers and students involved in pilot projects testified that active learning demands more time intensive preparation. The same goes for the services that provide logistic and pedagogical support. Within an environment such as a large university that is well-organized but has limited flexibility, the demand for a flipchart, for example, can engage a chain of procedures in between policy and operational services that makes the solution seem complex and time consuming. This causes misunderstandings between didactic teams and supporting services that might lead to complex or wrong logistic solutions for simple didactic problems. Moreover, falling in between different services and procedures discourages asking for exceptions needed to experiment with active learning. This reduces the chances for both lecturers and supporting services to gain experience with active learning that could lead to mutual understanding and streamlined procedures.

A similar problem occurs when it comes to designing and equipping NGC's. In comparison to the design and equipment of a traditional lecture hall, active learning spaces demand more expensive equipment. As the university's business model revolves around simultaneously teaching large groups of students, a decisive factor in efficiency measurement is the number of square meters per student. These aspects make active learning spaces more expensive and challenging than their traditional counterparts, for architects and designers, but also for policymakers.

PROGRESS IS DRIVEN BY EXPERIENCE

Progress is, in the context of higher education, mostly driven by evidence-based practice. The (eco)system evolves around small tweaks that may turn into broad implementations if they have proven their worth on a limited scale.

Adding small 'active learning' tweaks to the learning space and/or learning methods generates a variety of hybrid forms that float in between traditional learning methods and next generation teaching/learning methods. The pilot projects show that these hybrid forms are more likely to stress the disadvantages then the advantages. Within projects where both active and traditional learning methods were used, students reacted as expected according to Rogers's diffusion of innovation theory (Rogers & Everett, 2003). The respondents stated that the learning environments were adapted to only one of the multiple learning methods used and vice versa. FaulknerBrowns Architects (FaulknerBrowns Architects, 2018) sketches similar difficulties. Sightlines, acoustics and the placing of furniture need a different, sometimes contrary approach based on the chosen learning method. From this perspective, the implementation of active learning may not benefit from a step by step approach.

A second consequence of the experience-based progress is that it makes change heavily reliant on previous experiences. According to some stakeholders a lack of appropriate learning spaces, experiences and good practices keeps them from trying active learning themselves. Moreover: negative experiences of other teachers and students, or the lack of positive stories about active learning keeps lecturers and students from implementing it themselves.

IT IS HARD TO BREAK VICIOUS CIRCLES

A conservative environment, where active learning is conceived as expensive and time consuming and progress is based on experiences, does not offer the ideal breeding ground for successful transition to education based on active learning. Through the research phase a majority of frustrations and difficulties could be brought back to a lack of mutual understanding between pedagogy and space that reoccurs on different levels. Although progress was made in both fields, the split expertise, feedback loops, procedures and perspectives created an environment that discourages successful contacts and experiments that could give active learning the positive stories needed for a transition. The result of this gap is a vicious circle: the lack of use of innovative teaching practices reduces the demand for new and flexible rooms, which reinforces the traditional habits of teachers. Once one is stuck in this vicious circle it seems very hard to break it (Figure 2).

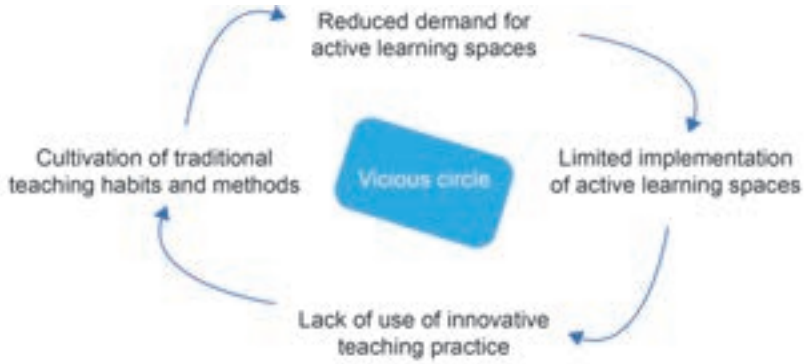

Figure 2. Vicious circle observed within the KU Leuven Association.

Linking pedagogy and space with ALINA

ALINA and later STEAM-ALINA focus on bridging the gap as a mediator or translator between pedagogy and space in order to break the vicious circle. By setting up interventions leading to mutual understanding it tries to turn the vicious circle into a positive spiral where pedagogy and space strengthen each other, creating an environment that can facilitate and stimulate qualitative experiments with both active learning methods and active learning spaces. In order to do this, five interventions were initiated: the foundation of a multidisciplinary taskforce; the dissemination of the insights of ALINA through recommendations for policymakers and lecturers; the design of the ALINA model and an accompanying proof of concept; a coaching trajectory for didactic teams and guidelines for (re)building active learning spaces.

MULTIDISCIPLINARY TASKFORCE

Stakeholders with various backgrounds that participated in the ALINA research phase were invited to elaborate on the subject within a multidisciplinary taskforce. The assembly meets every three months and discusses difficulties and opportunities for active learning. As it is exceptional that members from these backgrounds meet each other, the transfer of knowledge and contacts in this setting is very useful. The gatherings often lead to a shortcut in procedures or an exchange of projects that can inspire others and would otherwise stay under the radar. Occasionally the taskforce is consulted as experts in active learning by policymakers.

RECOMMENDATIONS FOR POLICY MAKERS

Start from a clear and holistic vision and remain faithful to this vision. In innovative projects, contradictory interests and practical difficulties often lead to modifications that weaken the original goals. When it comes to the implementation of active learning, it is important to guard the original plans and intentions in order to implement changes as they were meant. Hybrid solutions often lead to misconceptions, frustrations and a negative bias towards active learning.

Involve all possible stakeholders from the beginning. A lot of stakeholders are involved in the implementation of active learning, and all of them experience the change process differently. Make sure that most of the stakeholders stand behind the evolution by taking their perspective into account from the very beginning. A participatory design enhances the possibility that decisions and investments are well received.

Appoint a taskforce or a person as an ambassador of next generation spaces. The expertise needed for the implementation of active learning is fragmented. As it is difficult to gather different experts and projects around one vision, it helps to appoint someone or a team of people to act as a contact person. This ambassador can then explain the reasoning behind decisions and help with aligning different interests.

Define ownership. Keeping an overview of all proceedings is needed to remain faithful to the original intents. As a lot of stakeholders will be focused on their part of the project, issues falling in between responsibilities are easily overseen. It needs to be clear who has the final responsibility to address these problems.

RECOMMENDATIONS FOR LECTURERS

Start today with challenging, activating and stimulating your students. Fear of the unknown and a lack of initiative and expertise strengthen the vicious circle. Even small experiments can encourage others to do the same. A considerable amount of experiments with active learning helps to build up knowledge and experience and motivates policymakers to provide appropriate accommodation.

Give yourself time and space for trial and error to grow in your role as a 'coach'. One may not expect that a first attempt with active learning is as successful and rewarding as traditional learning methods that have been applied for ages. Gaining experience and confidence is the key.

Do not underestimate the influence of student attitudes. Students also need adjustment time. Students are often overlooked, but also for them it is a radical change. Give them time and support to adjust to the new learning conditions.

C*ommunicate with colleagues, exchange experiences*. Questions and insecurities are inherent to change, but when it comes to active learning a lot of human capital already exists. Sharing experiences speeds up the experimental phase and helps to find the appropriate learning method.

Use the available technical and didactical support. Not all adjustments depend on the didactic team itself. Pilot projects had a higher success rate when supporting services were involved.

THE ALINA MODEL AND TOOL

At the heart of the gap between pedagogy and space lies a difference in terminology and approach. Where technical services revolve around capacity, technology and equipment, pedagogical teams and services are concerned about support that enables certain learning activities. In order to formulate the correct answer to a didactic problem, a lecturer should pose questions as specific as possible, and the technical services need a limited amount of pedagogic knowledge. In order to ease the dialogue between pedagogy and space, ALINA designed a model and an accompanying proof-of-concept webtool that visualizes the relations between learning methods, pedagogic needs and technical solutions (Peeters & Binnard, 2018). The tool is meant to inspire stakeholders and to fuel discussion about the topic.

COACHING TRAJECTORY FOR DIDACTICAL TEAMS

Even before ALINA, the educational development unit of the KU Leuven offered educational support for didactical teams in the form of workshops, keynotes and individual coaching. Although these initiatives have proven their worth within the pilot projects, they often faced boundaries related to the equipment and the available learning spaces. At the same time, new technologies in renovated learning spaces were underused. Since then, technical services and pedagogical support have found each other in the ALINA multidisciplinary taskforce and have set up a coaching trajectory that tackles both problems. Didactic teams are given the chance to experiment with active learning in recently refurbished spaces. This is a triple win: lecturers can experiment in a safe environment; technical services receive direct feedback on recent designs and pedagogical services can offer support that is both pedagogical and technical. The experience gained will serve future pedagogical support, the design of active learning spaces and the lecturers themselves.

GUIDELINES FOR (RE)BUILDING ACTIVE LEARNING SPACES

In the current situation, the ownership of building and refurbishing projects is predominantly a technical matter. Other stakeholders, in particular those involved in pedagogy, reported that the process that these projects go through is unclear to them. In order to be able to improve projects with pedagogic know-how it is necessary that all stakeholders are consulted when their contribution is desirable. Therefore, ALINA aims to create guidelines that describe the course of events that precedes the start of the construction works. These guidelines also include suggestions that describe possible extra interventions that could raise the participation of all stakeholders and thus the implementation of pedagogic insights.

Conclusions

The ALINA and STEAM-ALINA projects consulted all stakeholders involved in the process of designing and using learning spaces in order to gain a better understanding of the reasons for the limited implementation of insights in active learning in everyday teaching practices and space management. By means of qualitative and quantitative research an overall picture of the efficient yet conservative setting that

discourages change emerged. An underlying cause became clear: a vicious circle in which missing connections between pedagogy and space create an environment that discourages the implementation of active learning spaces and experiments with active learning methods.

As a change manager, ALINA took the role of translator and negotiator in order to strengthen the dialogue between pedagogy and space. Through various initiatives ALINA and STEAM-ALINA elaborated to a momentum of interest in active learning. By sharing knowledge, encouraging experiments and improving the mutual understanding between pedagogy and space, it hopes to evoke a positive spiral that encourages and supports both active learning methods and next generation learning spaces.

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Open-plan learning environments and teachers' digital technology use

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Abstract

This paper reports on research conducted over one year in four Victorian government schools. The study sought to better understand teachers' choices to use, or not to use, technologies in their classrooms. This qualitative research took a Constructivist Grounded Theory approach (Charmaz, 2006) to data generation and analysis, and engaged nine teacher-participants as co-constructors of data.

Through iterative interviews, focus groups and classroom observations, teachers were seen to engage in professional learning embedded in their daily professional practice. Teachers reported and demonstrated that open-plan, shared teaching spaces impacted their learning with and of technologies. These innovative learning environments were seen to provide at point-of-need learning. Significantly, teachers positioned themselves as more likely to take risks and trial new digital pedagogies within shared teaching spaces, where their colleagues could share both successes and failures. This research has implications for leaders seeking to engage effectively with digital technologies in innovative learning spaces.

Keywords

LEARNING SPACES | OPEN-PLAN LEARNING | TEACHER LEARNING | PROFESSIONAL LEARNING | DIGITAL PEDAGOGIES | EDUCATIONAL TECHNOLOGIES

Introduction

Teachers in today's schools are positioned at a point in educational history where their day-to-day actions are increasingly mediated by, with and through technology. This research investigated the decisions teachers make in a technology-enabled classroom to better understand the factors that contribute to teachers' use, or non-use, of technologies for learning.

The research question in this study is raised amongst continued concern within Australia that students are not yet learning or accessing the digital resources that may improve their learning and their workforce readiness (The Regional Australia Institute, 2016).

Seeking to address this challenge, two major federal government initiatives have been completed in recent years. These were the Digital Education Revolution (National Building Education Revolution Coordinator, 2011) that saw all Australian 15-year-old students receive a laptop and the Building Education Revolution (National Building Education Revolution Coordinator, 2011) provided new buildings, teaching spaces and internet connectivity to schools in a $16.2 billion project across the country.

These two initiatives focused on devices and infrastructure, rather than on teachers or pedagogical strategies. This focus has been a critique of these projects and a rationale for the lack of change in teachers' practice and students' learning experiences (Crook, Sharma, Wilson, & Muller, 2013). This present research seeks to inform school teachers and leaders on the structures, both physical and personal, that may be successful in supporting teachers to move towards enhanced digital technology use. As such, the spaces in which they work in their schools are the focus of this present paper, within the context of teacher learning and classroom teaching.

Background and Context of the Research

This research has focused on a branch of digital technologies referred to as 'Web 2.0'. DiNucci (1999) is credited with first using the term "Web 2.0" (Cogburn & Espinoza-Vasquez, 2011; Dunlap & Lowenthal, 2011; Melanthiou, Kokkinaki, & Droussiotis, 2011) claiming that "the first glimmerings of Web 2.0 are beginning to appear..." (DiNucci, 1999, p. 32).

While Web 2.0 can be defined in a number of ways (Allen, 2009; Kamel Boulos & Wheeler, 2007; Murugesan, 2007) these definitions also have similarities in meaning. One commonality appears to be the concepts of:

- Collaboration
- Creativity, and
- Communication

The Web 2.0 subset of digital technologies has been identified as the focus of this research because of the challenges of the diverse uses of technology in the classroom. What might be considered low-level use of technology, such as creating a presentation or using email, does not have a significant evidence base to confirm its impact on student outcomes. Web 2.0 resources, such as blogs, interactive activities, online co-creation of resources or multi-media communications, do, however, have an emerging research base that suggests a positive impact of these resources on student learning. This research base has informed the choice of Web 2.0 as a valid focus for this research.

Research into the design and use of innovative learning environments offers additional insight into teachers' actions and learning strategies in the classroom (Fraser, 2014). Despite some research indicating that many school learning spaces remain traditional, teacher-centred classrooms (ILETC, 2017), teachers in this study taught in what can be termed 'Next Generation Learning Spaces' (Byers, Imms, & Hartnell-Young, 2014). These large open-plan learning spaces were shared between up to five teachers and 125 students. This paper reports on how teachers in this study used their shared learning space as a personal, professional learning space for their own learning.

Research Design

The major research question for this study engaged with the three concepts of Web 2.0 technologies, upper primary schooling and teachers' choices. The question was: **What factors influence and underpin teachers' choices when using Web 2.0 technologies in the upper primary school classroom?**

This research was conducted within Victoria, a state of Australia. Nine government primary school teachers were nominated by their school leaders as users of Web 2.0 technologies in their classroom.

The study engaged the nine participants in interviews and focus groups at their school. This was followed by a number of classroom observations within each of the teachers' teaching spaces.

This paper reports on one aspect of the study's findings and presents data and analysis of teachers' use of learning spaces as a professional learning environment. The researcher observed participants five times and interviewed them twice over the course of a calendar year. Each teacher in this research participated in one focus group with their teaching colleagues at their school.

The teacher participants in this study worked within open-plan, next-generation learning spaces (Byers et al., 2014). Working in this type of learning space was not a prerequisite for participation in this study, rather this coincidence emerged from the nomination sampling strategy.

Initial planning of this research called for two classroom observations of each teacher. It became apparent early in the project, however, that it would not be possible to observe one teacher working with one class group of

students, due to the flexible way in which the teachers taught and moved around the open-plan learning space. Each observation therefore focused on the interactions of teachers in the learning space both between each other, between teachers and students and within the physical spaces.

After each interaction (interviews, observations and focus groups) the data were coded and then shared with the participants for member-checking and further discussion. This process raised several themes that were validated across the four participating schools.

Theoretical Framework

The aim of this study has been to make meaning with and through teachers who have used Web 2.0 resources in their teaching practices to better understand how these decisions were made and what factors, including physical spaces, might support others to similarly use Web 2.0. To meet this aim, two complementary theoretical frameworks, grounded theory and positioning theory, were used to design and analyse data.

In taking a constructivist approach to Grounded Theory, in particular the work of Charmaz (2006), this study has iteratively questioned, reviewed and coded the data, seeking validation with participants of emergent themes. Constructivist Grounded Theory (CGT) (Charmaz, 2006) was an appropriate choice to develop new concepts and themes from within the novel and rapidly-changing space of technological, innovative learning environments and pedagogical change in primary school classrooms. Charmaz (2006) explains her definition of CGT as framed by an acknowledgement that, "… any theoretical rendering offers an interpretative portrayal of the study world, not an exact picture of it" (Charmaz, 2006, p. 10). With limited theory available to inform this study, it was seen as important to use a methodological approach that would not exclude new theory.

Positioning Theory (PT) (Harré & Langenhove, 1991) takes a dynamic, socially-constructed approach to human interactions and considers that individuals create social norms and acceptable behaviours through each interaction (Harré & Langenhove, 1991). Through interactions and speech acts, including gestures, language, body language, facial expressions and utterances, individuals position themselves in dialogue with others. In accepting, rejecting or re-positioning one another, groups develop norms that may impact both on their membership of a group and their personal behaviours. In this study PT provided a lens through which to focus on the language, positioning, team dynamics, personal learning and speech acts that teachers demonstrated within their teaching spaces.

In this study, grounded theory (Charmaz, 2006) provided a structure to generate data with the participants that honoured their individual voices and understandings. Positioning theory (Harré & Langenhove, 1991) provided a lens through which to understand that data.

Findings & Discussion

This section presents the results of twelve months of qualitative data generation and analysis. The key findings from interviews, focus groups and observations are detailed here with a focus on the voices of the teachers and their use of their open-plan learning spaces.

NEXT GENERATION LEARNING SPACES AS PROFESSIONAL LEARNING HUBS

This research identified ad-hoc learning and supportive interactions between teachers. These interactions occurred during class teaching time in the open-plan learning areas within which the four teams worked. Teachers were observed to leave the teaching space in which they were working and to approach another team member for pedagogical or technical support during a lesson. Support was always provided. This was either a short verbal reply ('yes, you can find it on website X'), an offer of an alternative digital device ('here, take my iPad for now') or through an offer to physically support each other ('bring your group over here and we will teach it together').

This point-of-need support was usually informal, rapidly provided and appeared to sustain teachers' use of technology in the moment. As a need was identified, support was offered quickly and with minimal apparent disruption to the classroom programs that were underway.

An example of shared support was offered by Sarah, who identified a moment of support that appeared significant to her as she began her teaching career:

> *…yeah, I was flustered, and it was my first year of teaching, and a teacher who was working on the opposite side of the room came over and said, 'oh I'll take your group while you go and set up an interactive white board.'*
>
> - (Sarah, School A).

Teachers commented that this ad-hoc support was facilitated by the open-plan learning space. In this open space, teachers reported feeling supported in their teaching because they could see other teachers at work and draw on those observations to inform their practice.

The open-plan teaching space within which these teachers work appeared to impact on teachers' personal learning and ability to implement and practice new skills. As David reflected:

> *It's really good being able to see, especially when we're actually teaching at the time, just seeing what other people are doing and going, yeah okay, I could do that in the next lesson…*
>
> - (David, School B).

Using classroom observation notes and diagrams, the interactions between team members were closely analysed to assess if any individual member within a team was approached for support more than the others. This may have indicated a hierarchical support structure where junior teachers sought support from those considered to be more senior.

Numerically calculating the interactions between teachers was challenging, as there were often more than two teachers involved in peer-support during a lesson, and the researcher was physically positioned in the centre of a large open-plan learning space. Analysis of the observation data suggested, however, that the giving and receiving of collegiate support at these three schools was at the approximate ratio of 1:1. This suggests that teachers used the open-plan learning space to both learn and support their colleagues equally. Teachers were learning while teaching as they observed their colleagues in action and approached them for support. These same teachers were also teaching their colleagues while they continued to learn, moving quickly and easily between the positions of teacher and learner, sometimes within the space of one conversation.

TEACHER COLLECTIVE LEARNING IN SHARED TEACHING SPACES

Collective learning reflects the idea that not all members of a group need to hold all the knowledge of the group. Each person may hold some knowledge that adds to the expertise of the team (Hord & Sommers, 2008).

In this research, teachers indicated that collective learning was indeed taking place, demonstrated by their fluid movements between being a teacher and a learner.

Senge et al. (2011) have similarly proposed that changed physical settings in a school may impact positively on the development of new skills in teachers.

Chen (2008, p. 72) has further suggested that the "environment surrounding the teachers has a strong influence on teachers' decision making". By bringing together research findings from Senge et. al (2011), Chen (2008) and this study there emerges a possible connection between the values that a school holds, the spaces they provide and how teachers choose to use technology.

This study offers examples of open-plan, next-generation learning environments (Byers et al., 2014) as learning spaces for both teachers and students. David succinctly acknowledged his use of space for learning and teaching by commenting that learning for his team was:

> *… just about being open about it, you'll learn from others, others will learn from you. It does benefit you in the long run.*
>
> - (David, School B).

Rachel similarly identified that her teaching environment provided her with learning opportunities to improve her practice:

> *When you see other teachers and what they can do you … sort of … you want to do that.*
>
> - (Rachel, School C).

FACILITATING CONNECTIVISM IN LEARNING SPACES

Connectivism, as defined by Siemens (2004), moves beyond traditional understanding of how learning occurs and sees changes in technology as having impacted on how we learn in the twenty-first century. With an apparent shift in how information is accessed and shared, Siemens (2004) suggests looking beyond ourselves, as individuals, to learn:

> *Over the last twenty years, technology has reorganized how we live, how we communicate, and how we learn. Learning needs and theories that describe learning principles and processes should be reflective of underlying social environments.*
>
> - (Siemens, 2004, p. 1).

Participants in phase one of this study demonstrated a range of learning strategies. These often included learning from and with others as part of their daily practice. The data from this research can be seen to validate Siemen's (2004) concept of connected learning that can help improve and/or change learning practices in schools.

The learning strategies that teachers demonstrated in this study indicated that learning was not seen by teacher participants as merely an internal event, but rather an external and dynamic activity that occurred in the space between individuals and in the physical spaces in which they worked. As Siemens (2014) states:

> *We can no longer personally experience and acquire learning that we need to act. We derive our competence from forming connections.*
>
> - (Siemens, 2004, p. 4).

For teachers in this study, knowledge resided both with themselves and within their team. This knowledge appeared to be accessed based on the learning needs of the teacher at specific points in time. These learning experiences took place in the open-plan learning spaces in which they taught. The spaces have appeared to support teachers' use of digital technologies for learning in the classroom.

Conclusion

This research project has sought to understand the ways that teachers make use of technological resources. A factor that has emerged in this research is the way in which learning spaces, initially designed to support student learning, may be impacting on how teachers learn new skills.

Participants in this study taught in large, open-plan learning environments. These non-traditional, shared teaching spaces appeared to facilitate collegiate teaching and learning at teachers' points-of-need. Teacher learning and support was seen by teachers in this study to be made possible through the shared learning space within which teachers could move quickly to provide or seek support.

It would be beneficial for future research to compare the practices of teams of teachers working in traditional classroom spaces with those in open-plan learning spaces. Researchers need to ask, "Do traditional, individual classroom spaces impact negatively on teachers' learning and the use of Web 2.0 technologies?"

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Can participatory design support the transition into innovative learning environments?

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Abstract

When changing from traditional classrooms to innovative learning environments it is crucial to include the users of the environment in the design process. However, participatory processes might be limited by contrasting expertise, cultures, priorities or project restrictions, which poses a risk to the alignment of spatial design and pedagogical practices. To meet this challenge, the paper proposes a post-design participatory activation process aimed to support the transition into new learning spaces. This is exemplified in an empirical case, where co-design methods and physical design objects have been explored as tools to foster spatial literacy and competencies in a fifth-grade cohort (teachers and students), and potentially match pedagogical practices with spatial affordances. Participatory activation is believed to be an ongoing process because learning environments are not static designs – they keep evolving based on people, pedagogies and practices.

Keywords

PARTICIPATORY DESIGN PROCESSES | INNOVATIVE LEARNING ENVIRONMENTS | CO-DESIGN METHODS | SPATIAL DESIGN | POST-DESIGN ACTIVATION

Introduction

When schools are built or rebuilt, there is a tendency to reduce classrooms and instead build new learning environments with a more open, flexible and activity-based interior. These environments are believed to promote a more personalised kind of learning and foster 21st Century learning skills like communication, creativity and critical thinking as they offer a variety of workstations to choose from.

It is often assumed that changes in teaching and learning will occur as a result of the changed spatial design (Blackmore, Bateman, Loughlin, O'Mara, & Aranda, 2011) but changing space does not automatically change practice. Changing from traditional classrooms to these new flexible learning spaces can be difficult as the new spatial setting requires a different way of teaching because of its particular affordances that do not support 'classical' teacher-centred teaching (Bøjer, 2018). Simply changing space is not enough (Bøjer, 2018; Imms & Byers, 2017), because, as Mulcahy, Cleveland and Aberton (2015) point out, there is not a strict causal link between a new learning space and pedagogic change.

Despite being designed to support student-centred learning instead of teacher-centred teaching, newly built learning spaces will not lead to innovative pedagogical practices if teachers are not prepared and provided with the necessary professional skills, tools and resources to change their practices (Blackmore et al., 2011). Instead, there is a risk of teachers retreating to the safety of their default practice if they are not being trained in how to utilise the affordances of the new space (Lackney, 2008).

This paper focuses on whether tools from co-design can be used to foster spatial awareness and bring focus to the potential of the space in supporting pedagogical practices, thereby becoming a means to help transitioning

from one type of learning space to another. I examine this through a case study, using co-design tools to create a discussion about the relationship between the physical learning space and pedagogical practices with a class of 5th graders and their teachers.

The potential of participatory design

Emergent research highlights the importance of involving the users in the process of change in a school (Blackmore et al., 2011) in order to create alignment between the spatial design and pedagogical practices (Könings, Bovill, & Woolner, 2017). Participation in the design of learning environments is crucial in order to account for the different expectations and perceptions of stakeholders. However, participatory processes might be limited by contrasting expertise, cultures and priorities (Könings et al., 2017), which poses a risk to the alignment of spatial design and pedagogical practices. To meet this challenge, this paper proposes a post-design participatory activation process aimed to support the transition into new learning spaces by using methods from co-design. Listening to and working with students and teachers can help transform both learning spaces and pedagogical approaches (Blackmore et al., 2011) and the involvement of students and teachers in participatory design needs to continue throughout all phases from design to evaluation in order to achieve sustainable impact within a rapidly changing context (Higgins, Hall, Wall, Woolner, & McCaughey, 2005).

The term co-design refers to design activities where designers and non-designers (people who are not trained in design) work together to develop new designs. Co-design has its roots in the Participatory Design tradition, where users were given more influence and room to provide expertise and participate in the informing, ideating, and conceptualising activities in the early design phases (Sanders & Stappers, 2008). Today, it spans across a broad spectrum of domains and makes use of a wide repertoire of tools, applications and techniques (Brandt, Binder, & Sanders, 2012; Sanders, Brandt, & Binder, 2010). Brandt, Binder and Sanders (2012) divide the co-designing activities into three different categories or 'toolboxes', telling, making and enacting, that respectively cover activities aimed to make people *talk* about existing practices and future visions or *make* tangible 'things' that are used to describe future objects, concerns, opportunities or ways of living or *enact* possible futures by trying things out – all of them to inform the following design process. The *tell, make* and *enact* activities are often intertwined and take place simultaneously in participatory design practices (Brandt et al., 2012).

The co-design approach has been chosen in this research project as it actively includes the participants in the design activities and has the potential to initiate a discussion about abstract pedagogical philosophical issues through a very concrete subject, for instance, the layout and experience of a learning space. In co-design, users, as 'experts' of their own experiences, become central to the design process as designers and non-designers work together to develop new design solutions. Users and other stakeholders are often involved in a series of workshops, where different tools and techniques are used to inspire participants to experiment and explore possible solutions by creating common tangible outputs (Lundsgaard, 2011).

Co-design is almost always used in the predesign phase to create a common platform from where the design can evolve. In this case, the co-design activities were separated from any design phase as a means to explore whether a co-design approach could help create spatial awareness and if co-design tools could potentially be used to activate the learning space in a post-design phase.

Case study

The case study is a public school in Denmark. For three months, a class of 5th graders and their teachers tested two pieces of furniture, aimed to support co-creation (hence called co-creation cabinets) and participated in three co-design workshops of 3-4 hours duration. The furniture was developed by Rune Fjord Studio especially for the research project and consisted of two unfolding cabinets that contained different functions. One was a small design studio with a combination of unfolding tables, a lightbox and storage space for materials and tools that was meant to create a frame for creative teamwork, (see Figure 1), whereas the other was a 'wunderkammer' with drawers and exhibition space, meant to be used when starting up a project or presenting results. Apart from the two co-creation cabinets, the spatial design in the learning space was the same as before the project. The participants were using both their regular classroom and an adjacent flexible learning space during the project.



Figure 1. Schjelderup, Sine. A co-creation cabinet in use. (Source: Author).

The intention of the project was to examine whether different co-design activities would provide the teachers with more insight into the needs and experiences of the students in relation to the interplay between learning activities and space. The methods used to collect data consisted of a mix of co-design tools (cultural probes and workshops) and ethnographic methods (observation, questionnaires and semi-structured interviews).

The workshops kickstarted, continued and closed the project. In all three workshops, the students were engaged in a series of co-design assignments with different telling and making activities, aimed to provoke discussions and create more awareness about the actual design of the learning space and the pedagogical practices taking place in the space. The assignments were planned in a way that was meant to build up to an increased reflection about learning spaces and activities. We started out in a more sensuous and non-reflective way in the first workshop by drawing intuitively to music, as shown in Figure 2, and ended up reflecting on different types of learning activities and building models of imaginative learning spaces. In the second workshop the object of attention was narrowed down from learning environment to learning furniture as the students were building multifunctional prototypes. The last workshop was mainly focusing on what they had learned and worked as an evaluation of the process, where the students rated pictures of learning spaces in relation to different learning activities, as shown in Figure 3, and answered a questionnaire. In between the workshops, the students and teachers worked independently with the co-creation cabinets as tools in their everyday educational activities, which was documented in a visual logbook on Instagram.



Figure 2. Drawing to sound, eyes closed, because sound is also part of the space. (Source: Author).



Figure 3. Matching learning space photos with learning space activities in workshop 3. (Source: Author).

The first workshop focused on the sensation of the actual space, the range of learning activities and the adequate functions in a learning space to support the learning activities. At first, the students experienced the environmental qualities of the space by listening to music under a table and drawing to sound with their eyes closed. Then they explored their physical learning space by placing post-it notes on the places or things they liked the most and least with a short description of why, in order to visualise how they each experience the space in different ways as shown in Figure 4. Subsequently, they listed and categorised learning activities and paired the categories with symbolic pictures, as shown in Figure 5 to form a foundation from which to build imaginative learning spaces, which was the final assignment of the workshop (Figure 6).



Figure 4. Bøjer, Bodil. An old worn-out sofa received most attention, both positive and negative. (Source: Author).



Figure 5. Bøjer, Bodil. The results of the co-design activity where the students listed learning activities and matched them with symbolic pictures. (Source: Author).

The second workshop took place midway through the process and had two purposes: to reflect upon the process that had passed and to continue the discussion about the relationship between learning space and learning activities. This time they only had one assignment, to design a prototype of a piece of furniture that would cover one or more needs in relation to the physical learning environment. The aim was to make them reflect upon and discuss their actual learning environment and the learning activities it supported – or did not support - in small groups, as well as gain insight into each other's needs and preferences in various learning situations. The most dominant need turned out to be tranquillity and concentration, and most groups designed

a multifunctional space or furniture that provided a soft place, where the students could withdraw to do concentrated work or relax, for instance a nook incorporated into a hole in the wall (pictured in Figure 7). This need was backed up by the teachers in the following interviews.



Figure 6. One of the finished models of learning spaces made by the students. (Source: Author).



Figure 7. A prototype of a nook where the students can withdraw to relax and read. (Source: Author).

In all three workshops, the students were reflecting on their actual surroundings while using them in a flexible way as they were allowed to individually choose where they wanted to work during the assignments. Many chose to sit on the windowsill, on the sofa, at a round table or in the hallway instead of at their regular tables when given the choice, which reflected their preference for a more diverse learning space.

Reflections and Findings

The co-design tools worked well to provoke discussions about the learning space and learning activities in an accessible way for the students. Most students were engaged and productive throughout the workshops and the co-design activities helped them discuss the abstract subject of the relationship between space and learning activities through a very concrete subject, the layout and experience of their learning space. Working with a series of minor telling activities that led to the two making activities created a common basis for discussion and reflection about the experience of the learning space, the needs of the individual students and the relationship between space and practice.

The many activities during the workshops as well as the use of the co-creation furniture made both students and teachers reflect upon their surroundings, which questionnaires, observations and interviews also showed. The discussions in the individual groups, the discussions and presentations in a whole group forum and the actual products and prototypes made during the workshops provided the teachers with good insight into the way the students experienced the design of the learning space and the way teachers use them. During the following interviews, the teachers expressed intentions of working more actively and flexible with the learning space design in the future.

The combination of workshops and co-creation furniture challenged the teachers both spatially and pedagogically – the workshops were aimed at creating reflection about the space and use, whereas the co-creation furniture actually pushed them into working in a different way because they had to think about how to include the cabinets in their educational activities and actually use them. This resulted in a more flexible use of the classroom and adjoining learning space as well as more creative assignments, for instance creative book reviews in boxes and mathematical percentage games. I would argue, that the combination of reflective and

practical work in their 'real' learning environment created an extra dimension of understanding that they would not have gained if either workshops or co-creation furniture were used independently or separated from their actual learning space.

Discussion and future work

In design research, there is a growing interest in design after design (Lundsgaard, 2011). As mentioned earlier, co-designing mostly happens in a predesign phase to establish a common platform from where the design can evolve. This paper explores how the co-design process can be extended to handle the transition into a new learning space by fostering reflections and a new awareness of the relationship between the physical environment and pedagogical practices. This might potentially serve to create a smoother transition for both teachers and students.

Co-design has the potential to become a tool in transition processes as it actively engages the participants in discussion and reflection about their physical learning space and pedagogical practices. In the featured case, both students and teachers became more aware of their learning space and the way they use it in their everyday educational activities, which might potentially help them create a better alignment between learning space and pedagogical practices.

The workshops presented in this paper were not part of an actual design process but took place in an already renovated school. In the future, similar workshops should be facilitated as part of a design process, especially in the transition phase after the design is implemented (Bøjer, 2018), to further explore the potential of co-design activities as a means of transitioning into newly-built innovative learning spaces. Often, when building new learning spaces, the interaction between the creators and the users of the spaces abruptly ends as soon as the new design has been implemented, which leaves the users with a spatial design they might not know how to use (Bøjer, 2018). A co-design process, like the one featured here, has the prospect of becoming a tool to help the teachers discover the potential of their new physical environment, because, as Higgins et al. (2005) explain, 'the process of user involvement must be continually refreshed and iterated to support ongoing change' (p. 3).

Many of the assignments used in the featured project could already be initiated in the pre-design phase and continue throughout the design process to the transition phase and beyond. Therefore, I propose co-design as a means of creating more spatial awareness that can be used throughout all phases of the design process and even as a separate tool after implementation of the design to potentially match pedagogical practices with spatial affordances. Participatory activation is believed to be an ongoing process because learning spaces are not static designs where 'one size fits all' - they keep evolving based on people, pedagogies and practices.

Acknowledgements

The empirical part of the project was developed in collaboration with my colleagues at Rune Fjord Studio and our partners at Højer Møbler. Thanks to all the people involved and to the students and teachers who participated in the project.

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Enacting teacher collaboration in innovative learning environments: Reifying pedagogical 'ownership'

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Abstract

The New Zealand Ministry of Education's policy move towards rolling out 'up-scaled' communities of students in Innovative Learning Environments (ILEs) across primary schools amplifies the requirement for teacher collaboration. For teachers though, the principles underpinning the pedagogical, spatial and relational enactment of collaboration set to potentially challenge long held practices with colleagues, students and space. One finding drawn from a broader case study on teacher collaboration in ILEs, illuminates the concept of 'ownership', and how this is articulated and interpreted at six sites. It utilises observational data, and interviews with teachers, students and school leaders, to describe a range of related pedagogical and spatial approaches. Implications for teacher teams are discussed though the development of a continuum placing enactment practices on a trajectory from fixed to fluid. It contributes towards the pedagogy/space discourse through a process of reification – taking the conceptual, related to 'ownership' - into the concrete.

Keywords

INNOVATIVE LEARNING ENVIRONMENTS | TEACHER COLLABORATION | NEW ZEALAND | ENACTMENT | PEDAGOGY | OWNERSHIP

Introduction

The transition away from individual classrooms towards collaborative Innovative Learning Environments (ILEs) in New Zealand primary schools presents a significant change to multiple aspects of teachers' work and workplace, not least to their relationships with *class* and *classroom*. The classroom has often encouraged associations with a 'territory of privacy and practice', encapsulating inferred accountability for those within (Clandinin & Connelly, 1996). In contrast, the pedagogy/space discourse portrays ILEs, in part, as an antidote to the enduring default association of 'one teacher - one classroom' places for learning. Instead, these 'up-scaled' communities are commonly home to 2 to 4 teachers with cohorts of up to 120 students. Described in terms of their relative openness, visibility, flexibility and adaptiveness to possible pedagogical scenarios ILEs are envisaged with innovative practices, student agency and teacher collaboration in mind (Benade, 2017; Charteris & Smardon, 2017; Ministry of Education, 2011). They are portrayed as constituting fluid, up-scaled socio-spatial assemblages within schools (Dovey & Fisher, 2014). Fluidity, as Dovey and Fisher (2014) suggest, being "a property identified with the multiplicitous practices of student-centred learning" (p. 19). Similarly fluid, the idea is that teachers are able to work more collaboratively in ILEs, to teach in a strength-based manner, adopt a higher degree of collective pedagogical variation and as a result, to better meet the needs of learners (OECD, 2013). How then, does new space translate into new forms of practice when collaborative, community and egalitarian principles are brought to bear on contemporary learning environments? Who is responsible for whom? Do teachers have their own class? Do students have their own teacher? Whose space is it anyway?

Teacher Collaboration

Teacher collaboration is predominantly viewed as a 'good thing'. Accordingly, the cultivation of multi-level deeper levels of collaboration has long been considered instrumental in leveraging large-scale shifts in students' educational outcomes (Fullan & Langworthy, 2014; Hattie, 2015). Much of this is attributed to increased motivation and morale alongside a reduction of teacher isolation (Vangrieken, Dochy, Raes, & Kyndt, 2015); in turn leading to higher levels of Collective Teacher Efficacy (Eells, 2011). Critically, by definition collaboration is concerned with giving something up for the greater good in order to achieve something that is not possible individually (Gray, 1989). This is an important factor when considered alongside ILEs, as examination from a spatial perspective suggests that although examples are evident, particularly in team teaching situations (see for example Villa, Thousand, & Nevin, 2008), much of what has been described as teacher collaboration has taken place outside the classroom. As McGregor (2003) noted, collaborative professional activities have often been restricted to the staffroom, team meeting or faculty office. How then is collaboration enacted in environments that appear reliant on it? Specifically, in the transition of teachers into ILEs, the enactment of teacher collaboration from a spatial perspective appears under-researched and under-theorised, yet provides a lynchpin underpinning the prospective success of ILEs.

Changes to learning environments

In comparison with traditional classrooms ILEs are characterized as having no 'front' (Cleveland, 2011), or at least a less identifiable one, along with clusters of settings and zones for particular learning activities (Fisher, 2005). The implication is that teachers and students may move fluidly between settings according to learning activity in much the same way that Activity Based Work theory is enacted in the integrated corporate workplace (Van Marrewijk, 2009). Theoretically the absence of a 'front' along with co-location of teachers renders the traditional 'built pedagogy' (Monahan, 2005) of the classroom, or the means by which school buildings produce and reinforce sets of social relations, potentially less perceivable. Consequently an implicit dissimilarity from a traditional classroom model is observed in the way space and place are conceptualised in these contexts; with ILEs emerge alternate possibilities of social structure, spatiality and power (McGregor, 2004).

The case study

This PhD research examined the intersection between teacher collaboration and ILE, and employed a qualitative, collective instrumental case-study design (Stake, 1995). Data in this phase was collected through observations, semi-structured interviews with principals, and focus groups of teachers and students. It was analysed using thematic narrative analysis (Riessman, 2008), and interrogated through a theoretical lens of collaboration (Gray, 1989). The short synthesis of data presented in this paper was gathered from ILEs in six primary school sites across New Zealand. Each site represented the spatial characteristics of either purpose built, or temporary (and awaiting reconstruction) ILEs, each operating with a team of teachers, varying in numbers from two to five. All were determined to be illustrative of teachers working together within shared spaces, with varying degrees of collaboration; each selected through a process of reputational site selection (Goetz & LeCompte, 1984).

Relational, pedagogical and spatial organisation in ILEs

Understanding how learners and teachers were organised and grouped in their ILEs formed an important early step in the research process and a critical reconciliation for each team of teachers to arrive at.

Often this was foundational to decisions regarding how learning, teaching and relationships were subsequently structured and practiced. Although all six sites studied were articulated as constituting ILEs espousing collective responsibility, teams of teachers demonstrated multifarious approaches to the way that responsibilities for, and relationships with, students and space were apportioned or shared. A key finding from the study, explored further here, illuminates this through the concept of 'ownership' in ILEs and how it is interpreted, articulated and enacted. Here three 'snapshots' from the study sites are used to illustrate some significant contrasts. Two ideas are explored; 1) Teachers' relationship with 'owned' cohorts within the ILE, and 2) their relationship with 'owned' space.

Lakeside Primary[1]: Purpose-built ILE consisting of a central area and five adjoining breakout rooms housed 58 students and three teachers, split into two Year 5 & 6 groups and one Year 7 & 8. Although the Year 5 & 6 students were observed to work with the other Year 5 & 6 teacher from time to time, the Year 7 & 8 students worked solely as an individual cohort, predominantly occupying one portion of the 'shared' space, and tending to utilise one of the breakout rooms. Teachers tended to base themselves at their own 'teaching station' (storage unit with inbuilt whiteboards and flat screen display).

Bridgeside Primary: Purpose-built ILEs (each with a central area, three breakout rooms and a semi-open teacher and resource space). The 41 Year 4-6 students were all presumed to belong to a collective learning space. For teacher Gemma this meant, "we might assess our own tag list of children but we don't just teach that tag list" (Gemma, teacher). Each teacher however, has primary responsibility, particularly for monitoring learning, reporting to parents, and for social wellbeing matters, of a 'tag list' of students. Learning took place with the team of teachers; with students opting into learning workshops determined by preference and negotiated need. Teachers were observed to move to different parts of the ILE depending in the activity and students they were engaged with.

Oakside Primary: A refurbished school awaiting rebuilding, the learning space consisted of a double sized classroom area with a small breakout space off the entrance area between them. Two teachers considered the larger cohort of 52 Year 3 & 4 students as 'our class', but divided the teaching to leverage their own expertise. The division meant that one was primarily responsible for all mathematics learning (conducted during the mornings) and the other for all literacy (during the afternoons). Teachers were responsible for all planning, assessment and reporting that were related to their subject area. One of the rooms was dedicated to this learning, while the second area was utilised for project and 'learning through play'.

Distillation of the findings distinguished that ownership in the ILE context could be translated into three particular elements: 1) *spatial ownership*, manifested through teacher occupation of particular parts of an ILE, 2) *administrative ownership* determined through responsibility for particular groups of students within the larger cohort (could include taking registration, collection of data, communication with parents, meeting with appropriate support staff); and 3) *pedagogical ownership* shaped by responsibility for teaching particular groups of students within the larger cohort (could include establishing student needs, learning design, assessment of progress and achievement, reporting). Each of these can be visualised as trajectories moving from *fixed* to *fluid*, and a continuum between. *Fixed spatial ownership* displays as individual teachers having permanent bases within the ILE, where personal items are stored, and from where the majority of their teaching is enacted – essentially a 'pseudo-classroom' within the wider ILE. *Fluid spatial ownership* by comparison translates as having no fixed space, instead shifting according to the needs of students, colleagues and activity. Similarly, examples of encountered *administrative* and *pedagogical ownership* are illustrated, again moving from *fixed* to *fluid* (see Table 1).

1. Note Lakeside and Bridgeside, are 'new schools' less than 5 years old. This accounts for the reduced cohort numbers.

Table 1: Trajectories of ownership in ILE.

Elements of ownership	Fixed	Examples of observed hybrids		Fluid
Spatial ownership	Teacher has own 'pseudo-classroom' setting within ILE. The majority of their activity takes place in a designated area. Space may be marked with personal items.	Teachers move within space according to timetable but may retain use of a recognised 'home-base'.	Teacher predominantly works in one space but has some responsibility for colleagues' students that requires repositioning in ILE (i.e. cross grouping/ station teaching).	Space negotiated with students & colleagues according to activity – teacher has no set default space of their own.
Administrative ownership	Teacher has own administrative 'class' unit within ILE. Their responsibility extends to all aspects of communication, administration and organisation.	Teacher predominantly has administrative responsibility for own 'class' although broader cohort of students may be considered as a whole e.g. for communication with parents.	Teachers have clearly defined roles for 1) their 'own' cohort of students and 2) subgroups of the larger cohort of students.	Teachers share joint administrative responsibility for all students e.g. communication with parents, reporting, engagement with external agencies is shared by group of teachers. Relative task allocation occurs on a needs basis.
Pedagogical ownership	Teacher works solely with 'own class' within ILE with little teaching interaction with other students.	Predominantly responsible for core group of students. Some cross-grouping of students with colleagues.	Teacher teaches all students in a particular curriculum area.	Teacher may work with any of the students according to activity, expertise & negotiated requirements.

Evident between the two ends of the continuum are examples of observed spatial and organisational *hybrids*. *Hybrid* is used here to describe practices that may retain more familiar elements of pedagogy, spatial use and accountability, but where teachers have sought to leverage from the opportunities engendered by amplified numbers of students and teachers. At some sites *hybrid* practices had been established as the 'norm' of practice, for example utilising a combination of 'class' group learning alongside regular cross-grouping, or 'workshop' style learning where students could opt into learning sessions with other teachers. In other sites they were more temporarily or sporadically employed. These could be described as examples of observed *elasticity* where some experimentation was evident but it was apparent that there was generally a default position to which things would return. Often this was articulated in conjunction with notions of evolving, idealised or aspired practice, where teachers could visualise and describe alternatives, and were working towards them as confidence, experience and understanding grew.

The paper began from the premise that ILEs are conceptualised as providing more contemporaneously relevant spaces for learning in primary schools in New Zealand; afforded by their openness, visibility, flexibility, and opportunity for teacher collaboration. The finding presented here, drawn from a wider study on teacher collaboration in ILEs, suggests that while this may be the case there is evidence of practices that are more firmly anchored in traditional classroom models. Some of this can be attributed to educational vision or to practices undergoing transition and emergence as teachers grow in confidence and understanding of what collaboration, together with space may offer in terms of pedagogical opportunities. To assist in this transition a potentially useful way to articulate the discussion is through the concept of *ownership*.

Discussion: 'ownership'

Psychological ownership relates to the feelings of ownership that people develop towards a variety of objects, both material and immaterial. It is concerned with meaning and emotion associated with possession, the relationship between individual and object, and affective sensations when challenged. Ownership has roots in fundamental motivations for efficacy, self-identity, and having a place (Pierce, Kostova, & Dirks, 2003). It can extend to other people (Belk, 1988), and secondly, to place: both "mine" and "ours" (Pierce et al., 2003).

In the primary school context both are familiar. There is strong symbiosis between students, the place that they learn in, and ties to an individual teacher. 'Being' a teacher has meant 'having' a classroom and a class. Relative ownership of classroom space has typically therefore been expressed as an element of professional life (Henkin, Vineburgh, & Dee, 2010). Despite practices of pedagogical deprivitisation being present in the vernacular of contemporary teaching and learning, these territory-based inferences often run strongly within schools (Goulding & Friedman, 2018). Furthermore, Henkin et al. (2010) has shown that efforts to develop more collaborative approaches are likely to evoke territorial concerns and conflict.

Conclusion

The idea that teachers are to work in ILEs together is under-emphasised, and presents a significant terrain for teachers to navigate and negotiate their way through. Ownership provides a useful lens through which to examine spatial, pedagogical and organisational tendencies. Conceptually it often pre-empts decisions as to how spatial, pedagogical and administrative ideas are structured and practiced; hence it is an important concept to recognise, theorise and apply.

Ethics approval

Data utilised in this research was obtained adhering to the ethical protocol current at the time of data collection. The research forms part of a PhD thesis and has been approved by the University of Melbourne Human Research Ethics Committee (1442559.1)

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Setting up an ILE from the mapping of knowledge flows

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Abstract

This work presents an overview of the recent research that has been developed in Brazil about the flows of knowledge inside an ILE for STEM Education. The research intended to understand how the teacher and the students (users) have experienced multiple learning processes trying to identify bottlenecks in the flow of information. The results can produce an improvement of the space and the pedagogies. N@MELAB is a laboratory of research about new learning environments and media that is developing a research methodology to create a map of knowledge flows, both in physical space and in cyberspace. This map can help teachers and learning planners to configure the environment to achieve its goals in the best way. This work shows some steps given in this direction in recent months.

Keywords

INNOVATIVE LEARNING ENVIRONMENTS | STEM EDUCATION | KNOWLEDGE MANAGEMENT | KNOWLEDGE FLOWS

The Starting Point

This work intends to present recent developments in research methodology of knowledge management for innovative learning environments. N@MELAB is a lab that works with innovative learning environments and it is working on the development of a research methodology that aims to understand the flows of knowledge inside learning spaces. The issues that guide this research are:

- Are there flows of knowledge in Innovative Learning Environments?
- How are these flows built?
- What is the role of non-human actors (objects, tools, software, furniture) in this process?

In this paper we did not focus on the answers to these issues. They will be answered in future papers. This paper describes two experiences that illustrate the mapping flows of knowledges in both cyber and physical spaces.

The Research Methodology

The development of this research methodology has gathered information from different fields of study like urban planning and social networks theory. The first one is Urban Planning. Learning spaces can be thought of as public spaces with streets, squares and neighborhoods. In all these spaces there are flows of people and knowledge all the time. Many urban planners have studied these flows before designing streets or squares. Jane Jacobs was not an urban planner, but an American writer and activist of urban life in New York. She wrote an important book in 1961 where she studied the role played by sidewalks, squares, bars and clubs in the cities (Jacobs, 1961). She realized that these spaces are meeting points of people where there are huge quantities of interactions. The casual meetings that happen on the streets, squares, bars and markets promote

interactions allowing knowledge exchange and progress of neighbourhoods and cities. In the USA during the fifties the focus of urban planners was on cars. Modernism defended the idea that cities should be designed for flows of cars not for people. Jacobs fought against this idea in New York, but she was not an urban planner. However, some architects, working with urban planning, took this idea and started to work in many cities around the world, transforming this idea into a program of research and action. Jan Gehl became one of the most important urban planners that worked with this program (Gehl, 2010).

Gehl developed a long-term study about the design of cities, thinking first of people and their interaction with space. He also created a methodology of research about the observation of flows of people and their interaction with urban furniture. He wrote a book with his colleague, Birgitte Svarre, where they presented this methodology of research to study the interaction between spaces and people on the streets. The observation of flows is the key to understanding this relationship (Gehl & Svarre, 2013).

The second field is the theory of social networks. We can think about learning spaces as a knowledge network formed by human actors (teacher and students) and non-human actors (stuff, devices, space design, software). Knowledge can flow in the physical spaces between the teacher and the students, or between students and objects, like pencils, papers, scissors, and pictures on the wall. But knowledge also can flow through cyberspace when the students use laptops, smartboards, tablets and smartphones. Space design is the most important element to give shape to these interactions because it is where these interactions happen. The position of furniture and the quantity or access points to internet (laptops, Wi-Fi or USB outlets) can change the network configuration. It is possible to think of each actor as a vertex and the flows of information as edges. The observation of the user experience is an important step to improve the flows of knowledge in learning spaces.

FIRST EXPERIENCE: MAPPING FLOWS OF KNOWLEDGE IN CYBERSPACE/PHYSICAL SPACE.

The school where the first experience was carried out was a Vocational High School in a small city (185,000 inhabitants) in the mountains of Rio de Janeiro State, Brazil (Braga, Guttmann, & Wilkerson, 2018). This school offers disciplines from the usual Brazilian High School curriculum and specific disciplines about Data Sciences, all integrated during the 10th , 11th and 12th grades. At the end of these three years, the students have qualifications to work in companies as technicians.

The teacher proposed a socio-scientific issue (SSI) in a class of the 11th grade. The SSI was a starting point for an advanced study of electromagnetic waves. The issue is based on a modern controversy about the dangers of electromagnetic waves for human health. This case is still under investigation in many laboratories around the world. The activity tried to introduce other elements to the issue, creating a higher level of complexity: a) If some damage to health was confirmed, how many people would be willing to give up on the connected society to preserve collective health? b) Would it be possible that technology itself could solve this problem? These questions were presented to students through two TV News stories watched before the first learning strategy.

The "Six Thinking Hats" pedagogy (De Bono, 1999) was used as a focus based on collaborative work. In this pedagogy, students go through six stages of approaching the issue. In each one, they might work in teams, arguing, getting data, expressing feelings or creating solutions in accordance with the goals of the hat. Each hat has a colour, and each colour signifies a different perspective pertaining to a focus. In this work the white hat focus was used to study where students should get information on the internet. The learning space was a flexible room. All furniture had wheels and the room could be used for multiple purposes.

The students chose to work in a traditional configuration, forming three groups of five, like in a scientific lab (Figure 1). They sat around the tables forming three workstations. There was one laptop over each workstation

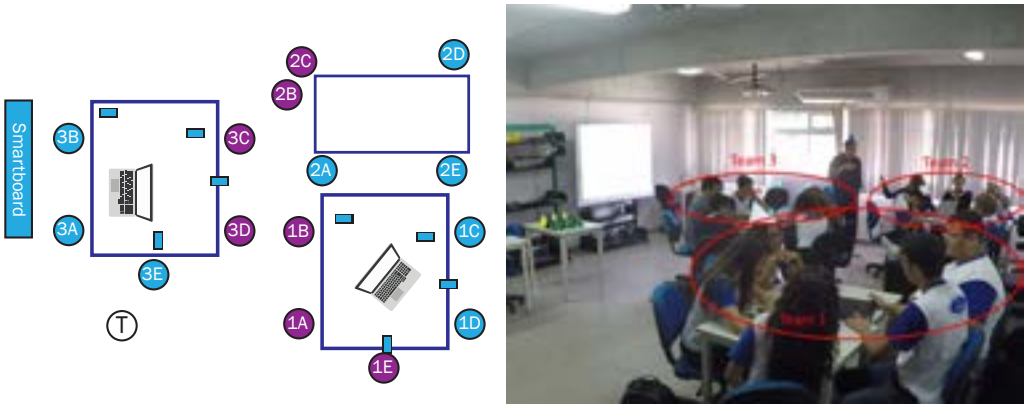

Figure 1. STEM multi-purpose environment. Teams 1, 2 and 3 with students identified by colors (genre) and letters. The initial position of laptops and the smartphones (black rectangles) were identified too (Source: Authors).

and all could use their smartphones for searching for information about the issue. All devices were connected in to "Padlet", an app that allowed posts of information on the table. Everybody could post information, and everybody could read it.

Footage of 9 minutes of the activity was selected for study. The researcher team made three types of transcriptions: (a) the device's movements (b) the flow of information in each one of the teams. (c) The conversation among all members of the team (Figure 2).

TEAM 1

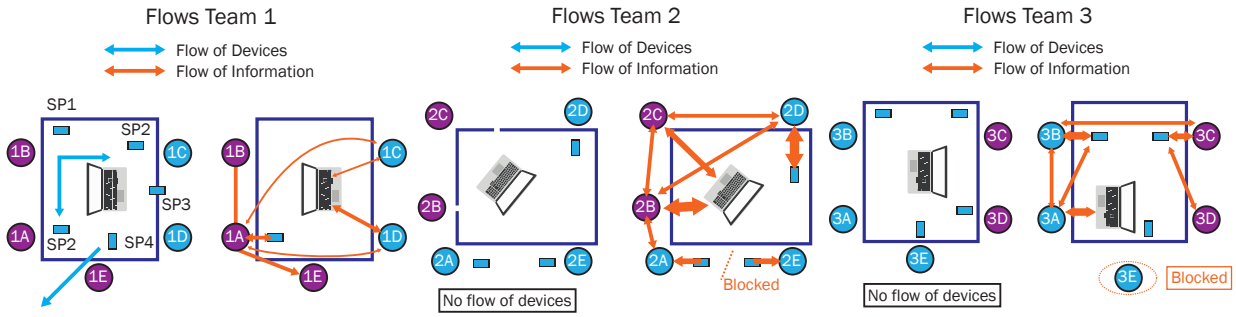

Figure 2. Flows of devices and knowledge inside each team. (Source: Authors).

Team 1 is the only one with device movements. Student 1C had a smartphone (SP2) in his hands. Student 1A asked 1C if he could borrow his smartphone. Then, 1A started using the smartphone and 1C worked with 1D on the laptop. However, during the process of consulting the web, student 1D was the one who used the web to get information. Students 1B and 1E were out of the process, only observing their colleagues working. Student 1E's smartphone ran out of battery. She looked for an electricity outlet to charge it. Then, she became disinterested and out of the process.

The flow of information happened within the human-device interaction process. The internet through the smartphones and the laptops was the only channel used to get information. When they found some information about the socio-scientific issue they directly sent it to the smartboard / Padlet. In this process, each group could interact with the others. Nevertheless, it did not happen. The Padlet should be a channel of interaction among the groups, but each one kept paying attention to their job, getting information and sending it to the Padlet.

In Team 1 students 1C and 1D used the laptop. Student 1A used the smartphone SP2 all the time and got most information from the internet that her group posted. Student 1D was the one that sent to the Padlet the information retrieved by student 1A. There was a heavy flow of information between 1A and 1D, but almost all the time from 1A to 1D. Students 1B, 1C and 1E were out of this process most of the time.

TEAM 2

In the team 2, all students interacted with the internet through devices all the time. However, it was possible to realize that student 2E was using the internet for other purposes. This information was registered by the teacher on the field notes. He noticed the interaction with the smartphone and the lack of interaction with his classmates. The other students worked with their smartphones (2A and 2D) or with the laptop (2B and 2C).

TEAM 3

Team 3 was the one with lowest flow of information among students. Student 3E did not interact with classmates and devices. Students 3C and 3D worked together using one smartphone and with low interaction with other classmates. Students 3A and 3B worked together with one smartphone and one laptop. They were exchanging some ideas and posted the major part of the posts of their group.

VISUALISATION

The complete visualization of knowledge flows both inside the physical space and cyberspace was made using the software Gephi (Figure 3). Some features of this process should be highlighted. The Smartboard/Padlet was the main channel of knowledge flows. In Social Network Analysis terminology, we can say that the Smartboard/Padlet (SBP) was the most important hub of the network (Barabási, 2002). However, the teacher had an important role. He was the second most important hub among the teams. He managed the process and provided some additional information about the socio-scientific issue when the students did not obtain the information on the internet.

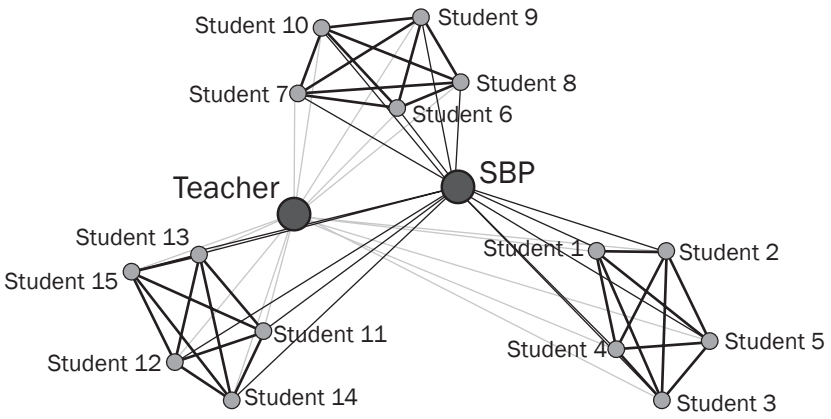

Figure 3. The map of knowledge exchange inside the physical space and on the cyberspace.

Second Experience: Mapping flows of Knowledge only in the Physical Space

The second experiment was carried out in the same space as the first one, but the researchers tried to solve several problems that had arisen at the time. Two cameras were used instead of one (Figure 4). In this experience, internet devices were not used. The students needed to make a bag using some materials.

They worked with pairs on the workstations. Some materials for common use were available on workbenches in the center of the space. The intention was to create a round-trip movement from the workstations to the central workbenches in order to encourage observation of the other works during this movement. But during the activity, the teams changed the process. They took away the materials (scissors and masking tape) and did not return them to the workbenches. With this, the tools played a new role. The students created a process of pollination of knowledge (Figure 5). The tools stayed at the workstation of the last group that took it. Students needed to walk through all the space searching for the common materials. Thereby, they had the opportunity to take a look in all the other projects. The knowledge was spread in the space creating a "spill-over effect" (Carlino, 2001).

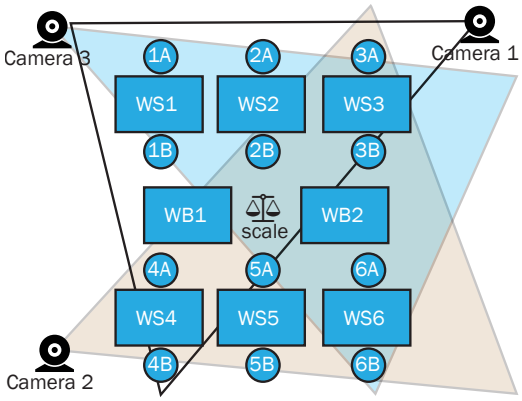

Figure 4. The position of cameras, workstations and workbenches.

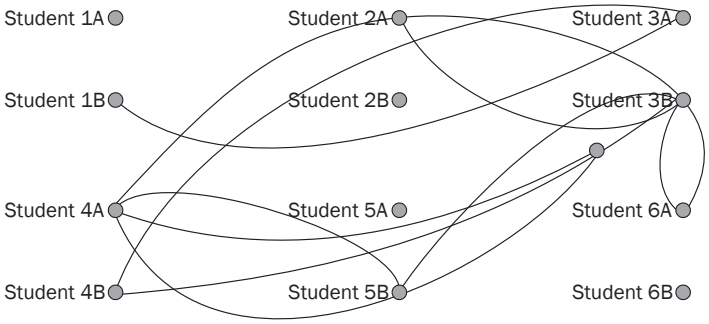

Figure 5. The pollination of knowledge created by the masking tape in the makerspace. The lines (edges) represent the tracks, not the direction of students' movement.

Two types of knowledge were exchanged during the activity. The first one was explicit knowledge. It is knowledge that can be expressed through words. The second one is knowledge that can be learned only through observation, knowledge that is not verbalized. It is knowledge of artisans, connected to the action of making things. This knowledge is called tacit knowledge (Polanyi, 1966).

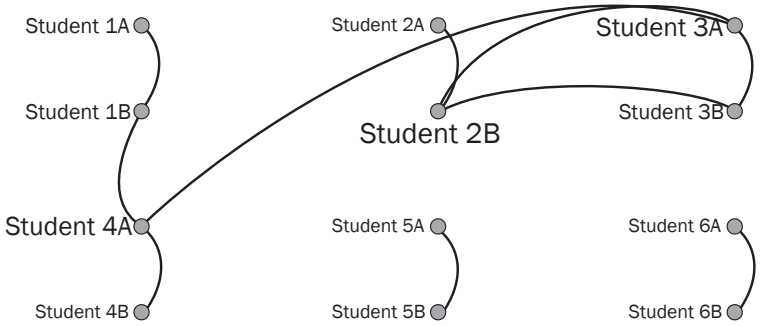

Figure 6. The topology of the exchange of explicit knowledge on the design of bags. The size of vertex indicates the level of connection as a hub.

Pollination is a process of spreading knowledge based on observation. Therefore, when students walk in the learning space, they can observe and learn from what their classmates are making. This is a characteristic of activities that use maker processes.

Figure 5 highlights the movement of students inside the space and shows the pathways to where knowledge can transit. Each student who took materials from another team's workstation also got some insight into the work processes of their peers. The next step of the research is to find out the type of knowledge that was transferred. Figure 6 shows us the pathways of explicit knowledge. It is the movement of the students exchanging knowledge through talking.

Conclusion

The research methodology based on observation of knowledge flows and the establishment of its topologies can create an important tool to understand the learning in different types of spaces. Students in their learning process create different pathways for knowledge that allow several types of configuration. The researchers must study these pathways trying to unblock them or build new pathways to facilitate these flows.

It is important to realize that the tables, chairs, walls, scissors, smartphones, smartboards are actors that play a role in these processes and cannot be forgotten (Latour, 2007). In the experiences presented in this paper, all these actors were fundamental to the learning project, from the masking tape to the setup of the workstations (connected tables) and workbenches. Innovative Learning Environments are a complex set of actors playing together.

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A post occupancy evaluation attempt: The Italian approach

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Abstract

The main purpose of the study is to investigate how teachers use active pedagogy in innovative school buildings and if the new spaces have affordances that impact on teachers' and students' behaviour. A mixed method research will be used, combining qualitative and quantitative tools (questionnaire, principal and teacher interviews, classroom observations). Four case studies will be produced (2 primary refurbished schools, 1 lower secondary and 1 upper secondary school that have modified one or more spaces) in order to highlight differences and common aspects in transition from traditional to innovative learning environments. As a result, we expect to identify teaching strategies that are used most often in innovative spaces and spatial elements that can foster the implementation of active pedagogies. Thanks to the role of Indire, the research results could have implications for other schools that can learn from good practices of innovation, as well as for policy makers to realize the necessity to change learning environments

Keywords

INNOVATIVE LEARNING SPACE | POST OCCUPANCY EVALUATION | SPACE AFFORDANCES | TEACHING STRATEGIES | COLLABORATION | CLUSTER SPACE

Theoretical framework

In the last five years Italian school buildings have been a main political focus of interest of the national government and the Ministry of Education. The reason for this novel interest is twofold. Firstly, many natural calamities such as earthquakes and other inconveniences such as lack of maintenance and technical adjustments have affected Italian school buildings. Secondly, the introduction and integration of ICT in daily activities in standard classrooms required teachers to change the classroom setting.

The national statistics about early school leavers, student outcomes and technical conditions of Italian school buildings provide a fragile scenario. Many schools - motivated by the necessity to change the educational model towards an innovative one based on pedagogies that better support students to become lifelong and self-directed learners - decided to implement some modifications of the learning spaces (http://www.indire.it/progetto/architetture-scolastiche/video/). The leading question towards this approach to innovation is: "what governance structures do we need to create to improve education?" and "how can we enhance and utilise the structures, resources and processes already present to improve the equity and effectiveness of education?". The answer lies in "complexity theory". Complexity theory posits that systems begin as collections of individual actors who organise themselves and create relationships. What the centre can do is to create a fertile environment that embraces the emergent nature of complex systems and work to create processes that maximise the flow of feedback between and across levels in a safe and manageable space (OECD, 2015).

Complex systems are non-linear (Snyder, 2013). Harnessing their power to promulgate change and create self-sustaining waves could be a practical way for policy design. Ecological science is providing certain solutions

to approach systems in a more manageable way. The Bronfenbrenner ecological model (1979) argues that the environment is comprised of four layers of systems which interact in complex ways and can both affect and be affected by a person's development. Bronfenbrenner later added a fifth dimension that comprises an element of time. This theory can be extended to model the complex systems of a school district or even of an individual school. The five layers of the model are (adapted from Johnson, 2008):

- Microsystem – interactions at the interpersonal level.
- Mesosystem – The bi-directional linkages between microsystems (i.e. teacher and student, or faculty and parent)
- Exosystem – The larger social system in which individuals act and which exerts influence upon them (i.e. the elements of the local community.)
- Macrosystem – The underlying cultural blueprint in which the system exists (i.e. regional or national level interests)
- Chronosystem – Both short and long -term time scales, which affect individual and systemic actions (the disconnect between the political and educational programme cycles, for instance).

While Bronfenbrenner (1979) highlighted the essential role of the learning environment to the development of the individual, Maxwell (2006) extended this concept by stating that "competency from an environmental perspective is the ability to interact effectively with one's surroundings" (p. 229). Children learn from interactions with their physical environment and from the people in their daily lives. Hence, it is important to understand the quality and characteristics of an environment that promotes competence and learning.

As Gibson (1979) suggested, space is characterised by *affordances* that suggest to the individual certain behaviour. Franceschini (1995) underlines the strong relationship between space and learning with the expression 'semantotopica', made up of two words: semantics, that is the study of meaning, and topic, that is the study of how spaces can be used. This should be very valuable for a school physical learning environment that is regarded as the "Third Teacher". According to Maxwell (2006), the following attributes contribute to the definition of the physical environment: control, privacy, complexity, exploration, restoration, personalization and legibility. Three of the above-mentioned attributes, *control, exploration and personalisation*, could be of some interest for the object of our research activity, since the characteristic of innovative learning space (ILS) introduced by some Italian schools help the students to develop such competency.

In light of the above changing scenario that Italian schools are experiencing, Indire requires a Post Occupancy Evaluation (POE) process by Italian schools involved in such a challenging situation. Although the POE approach has a long evolution outside Italy, our research activity would like to contextualise international POE tools and methods to the necessities of our national school context. Starting from the research questions that mainly trigger Italian school leaders and teachers, our approach evaluates the effect and the efficacy of the ILS on teachers' and students' behaviour and space affordances which can enhance a non-traditional use of space.

Research design

The research project will study examples of schools that have introduced one innovative learning environment into their standard buildings. Fifty five percent of the school buildings in Italy date back to before the first half of the 1970s (Italian Ministry of Education [MIUR], 2017). The majority of school assets are built according to old criteria. The urgency in our country is to renovate step by step, refurbish or reorganize old learning spaces without building from scratch.

Since 2014 Indire has been analysing and observing schools that have reorganized classroom spaces by buying new furniture or by reconfiguring old desks and chairs. We saw teachers use aisles in front of their classrooms to expand their learning environment. We studied schools that have implemented a different curriculum by introducing subject classrooms.

Seydel (2018) reports that across Europe three basic types of plan in school layout are emerging: the Plus Classroom, the Cluster Classroom and the Open Learning Environment (Figure 1). Seydel (2018) defines the Plus Classroom as "the extension of a conventional classroom with additional space and/or associated groups of classrooms", the Cluster Classroom as "the combination of several classrooms, an associated didactic area, more functional areas, and independent socio-spatial units" and finally the Open Learning Environment is "the dissolution of conventional classrooms in favour of large areas that are completely or partially open" (p. 189).

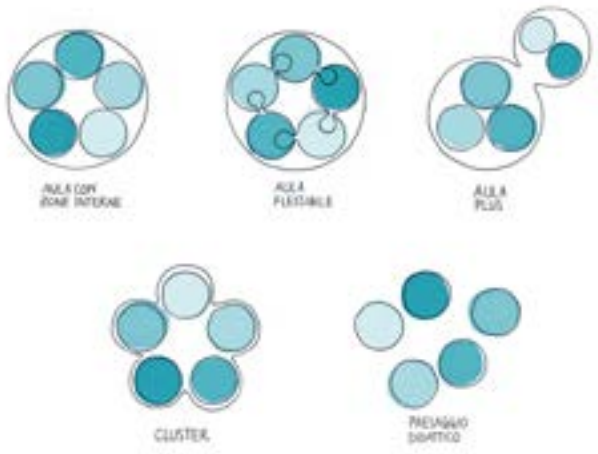

Figure 1. Cluster, Aula Plus and Open Learning Landscape. (Source: Leonardo, 2019, p. 131).

The main purpose of the research is to investigate the impact of the introduction of one of the three identified layouts on teachers' practices, on students' engagement, on teachers' and students' use of the space affordances.

The general research questions will be as follows:

- What are the effects of the new learning environment on teachers' innovative teaching practices?
- What are the effects of the new learning environment on students' engagement?
- How do teachers and students use the new learning space affordances?

A group of measures that may affect the behaviour in a specific space has been developed for each user (teachers and students). Items that investigate if the learning activities are interactive focused on teachers' introduction of new practices. As a result, they should probably be characterised by collaboration, class discussion, using feedback and organising lesson time (Kozma & Anderson, 2002). Student behaviour in an ILE is based on strong "agency". Hence, our interest is to investigate students' motivation to participate in school activities according to the Scott-Webber (2013) engagement factors such as collaboration, active involvement, physical movement, use of multiple materials, feeling comfortable. Finally, after identifying the space affordances, according to Gibson's theory (1979) and to Maxwell's attributes (2006), we will investigate what characteristics of innovative school spaces, in terms of tools, resources and settings, will influence teachers' and students' behaviour.

A preliminary investigation will collect information about the old learning environment in terms of space organisation, time structure and teaching practices. The same description will be included for the new learning environment. The core of the research design is based on user perception of spaces. We in fact experience our environments with all of our sensory faculties and with our motor system for action (Goldhagen, 2017). The project's configuration, its surface, material and texture, influence our sensory, cognitive, and especially our emotional responses to them, and in doing so, shape our experience.

Methodology

A mixed-method approach (Creswell, & Plano Clark, 2017) will be used. It provides a more holistic understanding of the relationship between human beings and space. The combination of quantitative and qualitative research approaches provides in this case a better understanding of the research problems than either approach alone. As the research needs to investigate a change in teachers' and students' behaviours related to the introduction of a new learning environment, we need to deeply understand the situation before the change (old/pre-learning environments) and the differences arising from the use of the new/post learning environments. To investigate the old/pre-learning environments phase, semi-structured interviews (Costa, 2016) and focus groups (Corrao, 2005) will be used. In to the new/post learning environments phase, space observations (Chiesi, 2009; Silverman, 2018) and questionnaires will be put in place. The table below (Table 1) summarizes the three dimensions taken into consideration by the research. Each of them is specified in macro measures.

Table 1. Dimensions of investigation.

Teacher's innovative teaching practices	**Students engagement**	**Space affordances**
Teachers' introduction of new practices mainly based on interaction and interactivity (Kozma and Anderson, 2002) 1. Interactive Instruction 2. Class Discussion 3. Collaboration 4. Providing feedback 5. Use of time	Student engagement factors (Scott-Webber, 2013): 1. Collaboration 2. Active Involvement 3. Physical movement 4. Use of multiple material 5. Feeling comfortable	How teachers and students use the objects (tools, furniture, technologies) identifying each of the 5 learning spaces from the "1+4 learning spaces for schools of the new millennium" Manifesto by Indire (Indire, 2016) according : 1. Exploration lab: space arranged to observe, experience, explore, experiment 2. Individual area: space arranged to concentrate, read, reflect 3. Informal area: space arranged to relax, read, talk, listen to music 4. Agorà (community area):space arranged to share experiences with the community 5. Group area: space arranged to create, present, collaborate, brainstorming, perform.

Investigation Sample

Among those Italian schools that designed and introduced innovative learning spaces, the sample schools that will participate in the POE research activity will include primary and lower secondary schools that have at least one or two years of pilot activity, so we can collect information about the previous organisation of the school and space use.

The "Montagnola - Gramsci" School is based in Florence. The building involved in the physical change has 100 students. The official standard evaluation of the school reports that standard tests of the students are average. The redesign of the "cluster space" (Figure 2) has been implemented to respond to students' mobility from the classroom to the external spaces. Their project aimed to address the students' wellbeing, and the learning activities have been organised so the students from the 1st grade to the 5th can work inside the classroom and in the area in front of their classroom. Once a week the learning activities are organised in multi-grades. The cluster allowed teachers to implement more collaborative activities, to use various spaces according to the students' needs and to create group levels according to the differentiation.



Figure 2. Cluster space in the Montagnola Primary School, Firenze, Indire. (Source: Moscato, 2019).

The "San Filippo" school is a primary school based in Città di Castello (Perugia), in the central part of Italy. It is located in the old town. Some of the building's elements date back to the XI century and some are from the XVIII century. Hence, it was impossible for the school principal to ask for structural changes. After having attended a conference on learning spaces organised by Indire in 2014, the school principal and the teachers realized that their spaces could not remain as they were. They decided to start a design participative process (involving parents and local community representatives) to imagine new spaces suitable for their students' educational needs. With a low budget and without moving any walls, they managed to transform the school layout by opening the 'piazze' (squares), using the portion of the aisle in front of two classrooms as a unique large learning space together with the classrooms. This pattern, consisting of the square plus the two facing classrooms, is what has been defined a 'plus classroom' type (Figure 3). It affects the space organization of the school, but also the didactic planning and the way of teaching and learning. Teachers can use three spaces at the same time: their classroom, that of a colleague and the square in front. A Plus classroom allows teachers to manage different learning activities and different working groups at the same time: small, large and individual study. It has been created by using lockers, different lighting and different colours on the wall as structurally non-invasive solutions to create separated areas along the aisles. Classroom doors are always kept open.

The "Teresa Mattei" school is a lower secondary school based in the surroundings of Florence (Bagno a Ripoli). The redesign of the school involves the entire building with around 300 students and 30 teachers of different subjects. The school has a two-level building with a large transition area and various halls for each level.



Figure 3. Aula Plus in the San Filippo Primary School, Firenze, Indire. (Source: Moscato, 2019).

The main change is the use of space outside the classroom and the halls for ordinary school activity (Subject Classroom). In order to use the space to the fullest, a teacher training activity based on collaborative and cooperative activities has been realized in the last school year.

The "Alessandro Volta" is a vocational school located in Perugia (central Italy). The school is attended by 1600 students and has 200 teachers, technical and administrative staff members. Since 2010, it has been involved in an innovation process by introducing and integrating ICT in the daily activities of the standard classrooms. From then on teachers started using different active teaching methodologies and understood the strategic role of space and setting to support students' learning practices and enhance their engagement. The school redesigned the classroom layouts by implementing a new educational organization based on subject classroom labs (Aula Plus). In the subject classroom labs, the structuring of the learning environment (furniture, materials, technologies) is specifically established in a disciplinary form; teachers remain in their subject classroom while the students rotate. We observed that this kind of configuration helped teachers and students to implement and use collaborative and cooperative practices.

Conclusions

The design of the POE approach that has been set up by Indire, aims at drawing a picture of Italian activity within the realm of space and pedagogy with particular attention to the effect that an innovative physical space could have on student motivation and teaching practices and the physical affordances of the space that promote competence and learning. The design described above is in its initial stage. The schools that will be involved in the investigation have introduced three different typologies of spaces, but they also had an impact on the general management of the school time and curriculum. Moreover, due to the national role of Indire, the final objectives are two-fold: at the Institutional level Indire has the formal task to produce recommendations for National Institutions, Local Authorities, Architects and School leaders to be included in public tenders to build new schools or to transform existing school buildings. At school level, Indire gives support to raise awareness among school stakeholders about their needs to design educational activities that impact on space and pedagogy and promote innovation with a holistic approach.

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Beyond the classroom: Learning spaces for a new generation of schools in Italy

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Abstract

What happens when the lesson is no longer limited to the walls of the classroom? What if a teacher could expand the learning environment to any other school places in order to promote differentiated and more powerful learning opportunities for the students? Indire's research builds on these ideas and takes shape in its "Manifesto 1+4 for effective learning environments" where a new school concept is depicted and extended beyond the classroom. "1+4" is a formula where "1" stands for the former classroom, now a modern learning environment that is open to the rest of the school and to the world and "4" stands for the school's main types of spaces: Agorà, Individual area, Informal area, Exploration Lab. The Manifesto has inspired a number of Italian schools who have shifted their approach from the "chalk and talk lessons" to more active and inquiry-based activities, affecting the design of their learning environment accordingly. This paper describes some of these best practices.

Keywords

EFFECTIVE LEARNING ENVIRONMENT | CASE STORIES | BEYOND THE CLASSROOM | MULTI-FUNCTIONAL SPACES | MODULAR SPACES

Indire research to innovate learning environments

Indire research on school architectures underscored how the traditional classroom constitutes a teaching tool that is by now too rigid and unsuitable for current teaching needs, which require instead multi-functional and modular spaces. Indire's survey on this topic was developed along a path characterised by three main guidelines:

1. International cooperation by taking part in the *Group of National Experts on Effective Learning Environments of OECD*;
2. Scientific support for national initiatives of educational policy through analysis and research of national realities and prime cases at international level in Denmark, Holland and Sweden;
3. Scientific support for schools and school networks that wish to undertake a local innovation plan.

The Indire approach does not simply aim to publish the results obtained, but intends instead to transfer the knowledge acquired from the theoretical to the organisational sphere by engaging schools and local companies. In this view, Indire collaborates with architects, representatives of administrations, teachers and principals in planning new schools and restructuring existing ones.

One of the main results is the model of 1+4 educational spaces for the new millennium. In the manifesto "1", the group space, is the multi-functional learning environment of the group-class, the evolution of the traditional classroom that opens up to the school and to the world, and an environment characterised by flexible spaces, continuous with other school areas. "4" are the complementary spaces, used in the traditional school only at specific times and alternative to daily teaching, they are considered in the model as part of a single and

integrated space in which the various micro-environments, aimed at different activities, have the same objective as the classroom and are flexible, fit for being inhabited and able to welcome people at any time. These spaces are: the exploration area, the individual space, the informal space, the Agora (Figure 1).



Figure 1. 1+4 educational spaces for the new millennium model. (Source: Istituto Nazionale di Documentazione, Innovazione e Ricerca Educativa, 2016).

Specifically, the **group space** is the area in which student groups gather and constitute their identity; it is a classroom no longer equipped with furniture rigidly arranged in front/teaching mode. This area is a place that may assume different layouts according to the teaching methods and programs to implement. It features flexible furniture in order to facilitate and support different teaching methods and more active approaches.

The exploration area is intended for learning through discovery and exploration of the world. It is designed to allow students to observe phenomena, analyse, describe, deal with practical tasks and solve problems. Examples of this type are the 'maker' space, disciplinary laboratories and full-immersion environments.

The **individual space** is a 'personal area' suitable for informal learning methods, in which skills that promote individual awareness and autonomous management of time, are developed. It is an area with sheltered spaces, niches, private environments and dedicated spaces where any student can go to read, reflect, study and undertake personal programs in a "protected" context. In this environment, the student can stay alone or with a tutor to perform activities that require particular facilities or a context able to favour focus.

The **informal space** is equipped for relaxation, with soft seats to rest, read or listen to music and/or tables and chairs for social moments between teaching/training activities. It can be considered as a separate environment or a group of facilities made available within the context of the other types of functional space.

Finally, the **Agora** is the area for the larger school community where seminars, presentations for large groups, and group lessons of teaching programs are held. It is a more convenient and informal alternative compared to the traditional auditorium or classroom, with seats arranged frontally for group events. The space is characterised by a large broadcasting or interactive screen, a projector, able to read any digital medium; a solution can be foreseen with a single stand in amphitheatre shape, or a solution with movable seats which can be re-arranged according to the type of presentation and audience size.

Four project types (Mosa & Tosi, 2016) stood out from observing Italian schools that re-conceived school areas, also according to Manifesto 1+4:

1. Schools that characterised a specialization of the classroom for a key disciplinary area;
2. Schools that re-conceived gathering, connection and transit areas;
3. Schools that set up one or more flexible and poly-functional classrooms ("3.0 classroom");
4. Schools that boosted the areas to support extra-curricular activities in line with the local community.

Based on this view, these types of projects found a practical application according to the experience of some Italian schools.

From theory to practice, examples of schools

The cases that have been analysed here belong to the school network that is part of a Movement to boost innovation in Italian schools, an initiative promoted by Indire in 2014. The goal of Avanguardie educative is ambitious: to implement the most significant experiences concerning the transformation of the organisational and teaching model of the school. The Movement accepts the participation of all Italian schools that work every day to transform the model of a school that is no longer suitable to the new generation of digital students and no longer in line with common society, focusing also on the opportunities offered by ICT and digital languages to change learning environments. For this purpose, Indire looks after and implements a "gallery of ideas" developed from the experience of schools, each of which represents the piece of the mosaic that aims at revolutionising the teaching method, time and space of "doing school".

The schools that joined the Movement and its principles since its foundation have exceeded 800. The vision of change is described in the Manifesto of the Movement, that is characterised by seven principles:

1. Transform the teacher-centered instruction model;
2. Exploit the opportunities offered by ICT and digital languages to sustain new ways of teaching, learning, and assessment;
3. Create new learning spaces;
4. Reorganize teaching time;
5. Reconnect the know-how of schools and the know-how of the knowledge society;
6. Invest in "human capital";
7. Promote innovation to be sustainable and transferable.

Despite being all interconnected, the principle that mainly concerns the reflection expressed in this brief text is no. 3 (create new learning spaces), in close synergy with no. 1 (transform the teacher-centered instruction model) based on the above guidelines.

The gallery of innovative ideas aims at supporting schools that intend to undertake an innovation plan. The ideas of the gallery that focus specifically on the learning environment are "TEAL", "flexible space" and "disciplinary laboratory classrooms". The first, TEAL, refers to a proposal of MIT in Boston, based on problem

posing and problem-solving logics. TEAL is the acronym of Technology Enhanced Active Learning and foresees the configuration of a classroom without a teacher's desk, with island-shaped stations equipped with a dedicated projection surface.

Among the various institutes that agreed to this innovative idea, we point out **Istituto di Istruzione Superiore Savoia Benincasa di Ancona** (upper secondary school in Marche region), one of the schools that, at national level, operates as TEAL's lead partner. According to the TEAL methodology, the learning environment is modified by re-thinking the teaching method that is no longer based on explanations, but on a few brief indications given by the teacher to solve a problem. The front facing lesson lasts the time required to set the initial problem and provide some indications for the work of the students who form groups of four/five members. This way, the teacher can see the progress of the work and offer the same content for all stations or a different content according to the group's organisation (whether the work is based on collaboration or cooperation, for example). The same school set up some multi-functional areas that were obtained from dismantling the IT laboratory (now obsolete due to the introduction of mobile technologies and the Bring Your Own Device, policy) where different educational activities are carried out that involve presentations, brainstorming, individual work, small groups, debates and homework. The photo (Figure 2) shows a setting where students debate in front of a podium defending a thesis "for" or "against" (according to the Debate logic, another idea of Avanguardie educative's gallery). It is worth mentioning that furniture in compressed cardboard with wheels is to facilitate the set-up and dismantling of flexible installations. This furniture was created thanks to the contribution of a local spin-off company that saw in this school, an opportunity for research and development.

The idea of "disciplinary laboratory classrooms" offers another option. Instead of setting up standard classrooms, which are the same for all the subjects, the classroom is customised in terms of furniture and contents that make it a real laboratory for the specific subject (e.g. Italian or mathematics).



Figure 2. Furniture in compressed cardboard for Debate activities. (Source: Authors).

The Italian school features many laboratories, first of all the IT laboratory, but not only: upper secondary schools are characterised by numerous laboratories dedicated to professional or artistic subjects (think of technical institutes or upper secondary schools specialising in arts or in music and dance, for example). However, according to this proposal, each subject features its own laboratory specifically designed for the characteristics of each discipline. The structural change of the classroom setting allows implementation of a

teaching method based on promoting skills favoured and facilitated by the environment itself, organised with mobile furniture and desks, equipped with libraries and specific technologies, with customisations that may also include the use of walls with temporary posters or paintings with educational and also decorative function.

In this case, the classroom no longer "belongs" to the class but to the teachers of the subject (teacher department) who are motivated to work in groups and cross-subject projects. The students rotate by changing classroom each hour, based on the daily program, as it takes place in university, thus emphasising autonomy and benefiting from the students' movement, which is very important to oxygenate the brain cells.

Many schools chose this solution and implemented it in their context; for example, **Istituto Comprensivo Falcone di Copertino** (lower secondary school in the province of Lecce, Apulia region), where the classroom specialisation based on subject is encouraged, as well as the use of spaces that are often considered secondary, as the halls (Figure 3) where students perform practical educational activities such as: jumping to empirically measure a length and do experiments on speed) and the garden. In the latter case, for example, the school garden offers many options to research basic materials (earth, a flower, a leaf) from which the work can be carried out, based on inductive approaches that are analysed in the class. Therefore the classroom becomes a *hub* from which a work can be started, and in which the results of "discoveries" can be shared, while working as a scientist or historian.



Figure 3. Istituto Comprensivo Falcone. Istituto Falcone Collection, Copertino (LC). (Source: http://www.comprensivofalconecopertino.it/).

Always referring to the school network of Movimento Avanguardie educative, it must be mentioned the experience of **Istituto Comprensivo Cadeo di Pontenure** (lower secondary school in Piacenza, Emilia Romagna region) that reviewed and redesigned the library in order to serve people frequenting the school (students, teachers and families) and also the entire municipality (lacking a library). It is a virtuous relation between school and territory that takes the shape of an aesthetically beautiful, comfortable environment featuring soft couches, paper and digital books. Therefore, this project was conceived with the aim to stimulate and support extra-curriculum activities in synergy with the territory. As added value, the above described environment is also used as gathering, study, rest place by students who stay at school after lectures (Figure 4).

Indire's manifestos also inspired the Principal of **Circolo Didattico San Filippo** (primary school located in Città di Castello, province of Perugia, Umbria region), frequented by about 1000 students and 100 teachers. In 2014, the school began a project consisting of re-conceiving its learning environments, aimed at transforming the school's physical spaces (classrooms, halls, refectory, outdoor spaces) in line with a pedagogic model



Figure 4. Istituto Comprensivo Cadeo di Pontenure Library. Istituto Comprensivo Cadeo Collection, Roveleto di Cadeo (PC). (Source: http://www.istitutocomprensivocadeo.it/le-biblioteche/la-chiameremo-osvaldo-cadeo/).



Figure 5. Example of learning cluster with common learning spaces.(Source: Moscato, 2018).

highly focused on laboratory activities, differentiated learning and active engagement of the students in all the phases of educational process (Figure 5). The school is an example of how it is possible to redesign an existing building, adapting it to a pedagogic idea, through a few structural changes.

One of the most evident aspects of Italian schools built in the '70s is the presence of large hallways, specifically conceived for the incoming and outgoing flow of a large number of students. The classrooms that face these hallways are environments of standard sizes with desks arranged in a row, a teacher's desk and, in some cases, technological equipment like a video projector or Interactive Whiteboard.

The goal of Circolo Didattico San Filippo was to re-organise the school as single and integrated space with various micro-environments characterised by a high level of functionality, comfort and wellness to execute multiple school activities.

The first change was to re-design the relation between class and hall: some classroom walls were eliminated in order to create educational continuity with the exterior. The old and vast halls were furnished with lockers, tables for group work, shelves with educational material, soft corners with carpets and sofas, stations with computers and tablets. These areas, called 'squares', are used by various classes and teachers at the same time, for different activities.

The classrooms are another element that breaks away from tradition: they no longer have a teacher's desk and personal desks, all the students rotate through group tables or other school areas, according to the type of activity to perform: small groups, large groups, individual study sessions, study or practical activities. Another element that characterises the school is the presence of teaching areas of experiential type and learning by doing. Those are scientific/mathematic and expressive ateliers, each featuring a specific setting linked to the disciplinary area. The work is highly dynamic in these spaces, the students mainly stand up and move around continuously to execute the various phases of the experiments. A soft corner is also present in the ateliers, equipped with natural rubber carpet and a sofa to relax, or also to use during brainstorming activities during which the students look for the most comfortable position.

Conclusions

The presented cases show examples of non-traditional learning spaces that modify the way to 'do school'. Students and teachers are in contexts that favour various activities, facilitating customisation and learning by doing. The areas feature flexible, multi-functional, modular solutions that can be easily set up according to the activities to carry out, and concepts for daily teaching approaches that are "close to the idea of a "learning studio" or based on the idea of the "learning community" (Biondi, Borri, & Tosi, 2016).

The analysis that led to the Indire model based on 1+4 educational spaces continues with some research aimed at studying the effects of re-conceiving the physical environment. In particular, one project aims at evaluating the sense of wellbeing of students and teachers who daily live a school area, organised to perform an educational activity focused on the student (study of psycho-social-cognitive variables); a second project studies the change of educational methods and roles of teachers and students in relation to the different reconfiguration of spaces.

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Well-being and environments: An exploratory study in primary schools in Italy

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Abstract

The study aims to investigate the impact on psycho-socio-cognitive variables when school environments are restructured. In particular, students' performances in terms of attention and concentration (D2-R test), students' self-regulation strategies (AMOS tests) and school well-being and risk factors will be taken into account, triangulated with data derived from test administration on teachers and families (QBS test). As for teachers' reactions, positive emotions, motivation and professional satisfaction will be considered by administering the MESI test. In addition to this quantitative analysis, a qualitative analysis protocol will be used, including focus groups with all the stakeholders and classroom activity observations. The sample will be created against a definition of school environment revision that draws on the "Manifesto for school environments", developed by Indire (2016). A semi-experimental research design will be put in place, with experimental and control schools selected against balanced socio-economic criteria.

Keywords

SCHOOL ENVIRONMENTS | WELL-BEING | SCHOOL COMMUNITY | EXPERIMENTAL DESIGN | SOCIO-COGNITIVE IMPACT | AFFECTIVE IMPACT

Introduction

The research design which is described in this paper aims to investigate the impact that an innovative learning environment, referred to as an "ILE" (OECD, 2013), might have on school community stakeholders, students in particular[1]. It is a research project which is being carried out by Indire, the Italian National Institute of Educational Documentation, Research and Innovation within its three-year research plan. Indire has a long history of research into educational innovation, but only recently have researchers started investigating the outcomes of school physical settings - when restructured or rebuilt - on students' (and school community's) well-being.

The interest in the physical school setting (furniture, architecture, physical resources) is not new in educational research (Davies, et al., 2013). In 2016, Indire released a *Manifesto for learning* spaces describing the 4+1 settings an innovative school should encompass to guarantee rich and meaningful learning experiences. The 4+1 spaces are: the individual area, the learning group space, the exploration lab, the Agora, and an informal area for several kinds of informal activities. However, the relationship between these spaces and the students' well-being have not been investigated until this study was designed.

1 The definition of an ILE by the OECD, which is referenced in this work, is a learner- centred physical setting, founded on the social nature of learning, that considers students' motivation and emotions as key elements in achievement; fosters personalisation; foresees challenging tasks (but avoiding overload); provides feedback and formative assessment; promotes horizontal connectedness among disciplines.

A Framework on well-being connected to innovative learning environments

As pointed out by Blackmore and collaborators (Department of education and early childhood development, 2011) in their literature review of over 700 primary documents, many research activities concentrate on the connections between built environment, use of learning spaces and learning outcomes, even though very little can be said in terms of direct causal effects between these variables. "The review identified very little empirical evidence associating any of the above phases with specific regard to student learning outcomes" (Department of education and early childhood development). The most advanced position is that, "The connection between learning outcomes and built environment and use of learning spaces is thus mediated by tangibles (e.g. quality of air, light, spatial density) and intangibles (school and classroom culture, sense of belonging and self-efficacy) as well as teacher-student relationships among other mediating variables.", the review states (Blackmore, Bateman, O'Mara & Loughlin, 2011, p. 5).

What we would like to better understand here is the relationship between an innovative learning environment and students' (school community's) well-being. To do so, we started by analysing several types of sources in literature: some dealing with the connections between space and learning outcomes and some (few) dealing with the connection between space and students' well-being. The sources we mainly consulted are briefly mentioned below:

1. Environmental psychology works, especially dealing with the concept of embodied cognition (Shapiro et al., 2007), arguing that cognitive processes (hence learning) are not limited to mind-content interactions; cognition is done through the entire body, since we are "embodied organisms-acting-within-environments" (Mallgrave, 2015, p. 1), and our interactions with the world are grounded in our sensor-motor and perception systems (Lakoff & Johnson, 1999; Noë, 2004; Clark, 2008; Chemero, 2009).
2. Neurosciences and mindfulness pieces of work (Vigilante, 2017), insisting on the importance of emotional, perception, proprioception variables when school architecture is considered, in relation to "readiness for learning" and to the *affordances* that architecture might ensure.
3. International research works and tools (i.e. the work by OECD on LEEP and its corresponding questionnaires, 2014, 2018) on the impact of learning spaces on learning outcomes and on students' well-being.
4. Psychological tests measuring school community well-being (students, teachers, families, etc.) in their context, in order to be sure to include all the dimensions of the construct.
5. Papers describing research design or activities having a scope similar to ours.

In an attempt to define the concept of students' well-being, Powell and collaborators (Powell et al., 2018) found that students consider the following dimensions as key components of their well-being: positive Self-concept beliefs, and good relationships with teachers, peers and significant others. Another study on 7th grade classrooms (Yerdelen & Sungur, 2018), focussing on the role of students' perceptions of learning environments and teacher effectiveness, found that learning environment variables were good predictors of students' self-regulation in learning science. Among the learning environment variables, task-orientation appeared to be the most powerful predictor of self-regulation. Additionally, teacher variables were found to have direct relations with students' self-regulation and moderate the relationships between the learning environment and students' self-regulation variables.

This analysis turned out to be very complex yet useful to come to a personal schematisation of students' well-being connected to learning environments. The framework is illustrated below. It has to be said, however, that well-being might have a twofold nature:

- Immediate nature.
- Durable/Deep nature.

The first type is connected to students' experiences that might be rather immediate if students are exposed to an innovative environment and, in this sense, well-being is, let's say, a more phenomenological construct. The second nature, on the contrary, calls for the need to be worked on and the resulting well-being is not immediate; it is deeper but slower to come about.

Dimensions of well-being connected to an innovative learning environment are described below, in a sort of crescendo system, in what we call the 'Pyramid of well-being' (represented in Figure 1):

1. **Physical well-being**: the first perception of well-being that is experienced by students in an innovative learning environment is the feeling of being comfortable in a well set and safe space, where light, colours, sounds, air and movement are designed in a way to reproduce a sense of "nesting" (Robinson, 2011). This is the first bodily and neural effect - perceived by the *Synaptic Self* (LeDoux, 2002) - that an innovative learning environment provokes on the student.
2. **Emotional-affective well-being**: second in the pyramid is partly the side-effect of the previous one. Feeling in a safe place, at ease and living an aesthetic experience because of colors, light, beautiful furniture, and air, engenders feelings of happiness, absence of anxiety, readiness, openness, as stated by neurosciences: We feel, 'that's why we learn' (Immordino-Yang & Damasio, 2007). This dimension also includes the sense of satisfaction that the students perceive because of the *affordances* and the "metaphors" of a place that allows freedom and encourages the learners to take responsibility. The satisfaction for the accomplishment of learner-directed activities is also considered here.
3. The third dimension in the pyramid is the **socio-relational** well-being. When a space is designed to facilitate openness, movement, informal meetings, people experience and more numerous, deeper and richer encounters. Architects speak of *affordances* and "readiness to learn" that innovative learning environments encourage. This dimension encompasses two of the 4C's (collaboration and communication) that can be differently developed in an ILE.
4. The fourth, more complex step in the pyramid, is the **strategic dimension** (De Beni et al., 2014), defined as the "active process through which the student defines his/her objectives and strives to monitor, adjust and control his/her cognitive processes, motivation and behaviour in relation to those objectives and according to personal and context constraints and characteristics" (Boscolo, 2012). When dealing with learning experiences, deep learning, and cooperative learning models, innovative environments are crucial. In an innovative learning environment students are driven to concentrate, be more autonomous, to experiment, to take responsibility, to be active, to express their sense of agency (Gallagher, 2000) and tend to develop cognitive and metacognitive competences that in a traditional, transmissive learning environment are not (or rarely) required. This category includes all the strategic beliefs about the students' own efficacy (Bandura, 1997), self-regulated learning strategies and concentration/memory capacities connected with the experience of learning. Therefore, this dimension encompasses both cognitive and metacognitive competences that are fundamental to process inputs and generate any sort of output (such as concentration, memory and selective attention) and to do it in a creative manner. One of the 4C's, Creative Thinking, is connected to this dimension.

The pyramid is not complete, though. If a school invests in the space as a crucial endeavor in learning opportunities, with participatory design initiatives, for instance, two other higher-level dimensions are likely to be affected:

5. The **behavioural dimension**: in a learning space that students are called to personalize, change or even design, students tend to refrain from vandalism, aggressive behaviours and tend to seek and search for help, perceiving a sense of psychological safeness and of bonding (Phillips, 1990), that is, a sense of being connected to people/places, being cared for and regarded as an object of love.
6. The **identity dimension**: as a result of recurrent interactions between the environment and the student's experience of control and meaning creation (Phillips, 1990), the student might arrive at identifying with the place, as a part of the Self. This is a status that cannot be immediate, but needs to be envisaged, recognised and sustained by the school community in a durable manner.

Aims

The primary purpose of this study is twofold: on the one hand, to gain a better understanding of the interrelation between the dimensions of our well-being framework and an innovative learning environment; on the other hand, to examine the relationship between the adoption of active teaching methods and the reconfiguration of a flexible space.

In particular the research investigates the **strategic dimension** in term of attention, concentration and students' self-regulated strategies; the **emotional-affective** dimension, or the students' anxiety; the **socio-relational** dimension, especially as for peer relationships and teachers' and parents' support. The dimension of **physical well-being** will be analyzed looking at the students' feeling of being comfortable in the space. The school well-being and risk factors will be also taken into account and triangulated with data derived from test administration to teachers and families.



Figure 1. The Pyramid of well-being connected to innovative learning environments.

Methodology

The research embraces a qualitative-quantitative approach: this mixed method combines focus groups and observations with questionnaires and standardized tests.

PARTICIPANTS

The sample will be selected from the last years of primary schools, with students that have completed a cycle of studies in the school space that reflects the characteristics of the Indire's *Manifesto for learning spaces*. The schools selected have modified the layout of one or more classrooms in order to make it a multi-purpose space that facilitates the diversification of activities.

The classes identified have functional areas for five different activities described in the *Manifesto*:

- Presentation: setting organized for the presentation of the contents and of the students' work (one to many configuration).
- Collaboration: setting for collaboration, cooperation and group work.
- Brainstorming: setting for discussion, interaction and generation of new ideas.
- Performing: setting for individual activities, reading, listening, testing, exercising.
- Creation: setting for the design and creation of artifacts or multimedia objects.

There will be a selection of 3 or 4 schools that can guarantee at least one control class where students have not been involved in the rethinking of space, nor have been exposed to innovative learning environments.

RESEARCH TOOLS

STANDARDIZED TESTS

- The QBS 8-13 test (*Questionnaires for the assessment of school well-being and identification of risk factors*) (Marzocchi & Tobia, 2015), which analyzes the well-being of children aged from 8 to 13 at school, through three questionnaires that consider the point of view of parents, teachers and the pupil. It provides scores on satisfaction, relationship with teachers, relationship with classmates, emotional attitude at school, sense of self-efficacy and causal attribution processes.
- The AMOS 8-15 test (*Test on study strategies*) (Cornoldi, De Beni , Zamperlin & Meneghetti, 2005), which assesses the students' self-regulation strategies, strategic awareness and beliefs about their learning process.
- The D2-R test (*Test on attention and concentration*) (Brickenkamp, Schmidt-Atzert & Liepmann, 2013). It is a culture-free test that examines attention, concentration, and processing speed; indirectly, it is possible to derive important indicators: accuracy (relationship between speed and precision) and work style (relationship between concentration and accuracy).
- The MESI test (*Questionnaire on teachers' motivations, emotions, strategies of teaching*) (Moè, Pazzaglia & Friso, 2010) to examine the teachers' reactions, positive emotions, motivation and professional satisfaction.

QUESTIONNAIRE

Some items from the School User Survey 2018 (OECD, 2018) "Improving Learning space together" will be adapted to understand the relationship between the arrangement of the space and the students' learning experience.

QUALITATIVE TOOLS

In addition to the quantitative analysis, a qualitative analysis protocol will be used, including focus groups with all the stakeholders and classroom activities observations to understand the opinions and attitudes towards the change of spaces and the teaching practices.

Expected results

The research is now under way. We expect to find statistically meaningful differences in the students of experimental classes for the first four well-being dimensions of the pyramid. Our research hypothesis is that experimental students have higher levels of concentration than control students, that they developed better self-regulated learning strategies and experience fewer negative emotions. We also expect to detect in experimental students a greater openness and higher proactive attitudes due to a learning process based on peer-collaboration (facilitated and afforded by specific learning spaces) compared to control students. Finally, as for physical well-being, we expect to find differences in the questionnaire scores and reports between the two samples. The triangulation of data is expected to corroborate the data we will gather from students. If our hypothesis is confirmed, it would be interesting to apply our framework and research protocol elsewhere, not only in Italy.

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A learning space contributing to the process of computational thinking

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Abstract

Substantial transformations in modern society puts pressures on educational systems to reflect new competencies in solving complex problems including computational thinking (CT) which provides new methods of approaching problems in multifunctional, diversified, comfortable and engaging environments thus leading to organizing new learning spaces (LS). Our case study investigates the relationship between learning space and the process of computational thinking. We aim to make the process of computational thinking explicit in a context of middle school students creating a robotics challenge, and to identify the characteristics of learning spaces that influence this process. Our main finding is that new learning spaces amplify students' capacity to handle the task of creating, validating and sharing new knowledge thus increasing their potential to become successful 21st century learners.

Keywords

LEARNING SPACE | COMPUTATIONAL THINKING | PROCESS OF COMPUTATIONAL THINKING

Introduction

The recent exponential growth of society due to the pace of acceleration brings major changes to the world (Friedman, 2016). How should education reflect these changes, in respect to the constant evolution of Information and Communication Technology (ICT) which has transformed society into a new paradigm in the economy where companies have changed their processes and redesigned workplaces (Zhong et al., 2016)? In this context, the role of new skills such as communication, collaboration, problem solving, and innovation has significantly increased (Cobo, 2013). Hence, the widening gap between the school system and the digital world is well documented in the literature (Chiasson & Freiman, 2018). Accordingly, the Ten-Year Education Plan (Nouveau-Brunswick , 2016) reinforces the commitment of the New Brunswick government to: "Increase opportunities that require learners to apply knowledge and skills within and across disciplines to innovate and solve real-world problems."

Today, the learning landscapes in schools, still rooted in the 19th and 20th century models, do not reflect the way of living, working and learning in the 21st century. It is thus imperative to transform these spaces by seeking inspiration from other models, such as in industries where employees need to solve problems, innovate, collaborate and communicate effectively. Therefore, computational thinking becomes a new skill essential for solving complex problems. On the other hand, schools emphasize the technical and computer aspects (coding and programming) and not the process of learning. There is still no research that highlights the links between new types of learning spaces and this process of problem solving using CT skills. This environment combines the most recent technological advancements, new types of digital tools for the development of computational thinking skill and new types of pedagogy, which is learner-centered and problem-based.

This paper reports the first results of a case study where grades 6 and 7 students designed, solved and shared robotics challenges using iPads, Swift Playgrounds application and robotics in a learning environment (Figure 1) specifically designed to reflect real life workspaces where complex problems are addressed with a collaborative approach. It allows for new problem-solving methods involving computational thinking as a key 21st century competence, essential yet still misunderstood and under-researched. While contributing to the field of research, our study seeks to understand how new learning spaces interact with new ways of solving problems.



Figure 1. Physical Space/Learning Space Environment. (Source: Author).

Objectives

Setting up a learning space to anchor active learning with computational thinking concepts and approaches will achieve the main goal of our study, which is to understand the relationship between learning spaces and the process of computational thinking. The preliminary work done by Competi.ca partnership network (Chiasson & Freiman, 2018) allowed to pursue the investigation analyzing how students apply the process of computational thinking while conceiving, testing and presenting a robotics challenge in a technology-enriched environment and how particular characteristics of the learning space can influence the process of computational thinking. Our second goal is to capture some preliminary experiences of teachers who have been adapting to this new learning space.

Theoretical perspective

Studies highlight that workplace learning enhances individual and collective engagement (Kersh, 2016). With diversity and socioeconomic status impacting all aspects of life, including teaching and learning, spaces that cater to diverse learning needs and styles will motivate and engage students (Djambong & Freiman, 2016). According to King et al. (2014), collaboration, innovation and student participation improve in flexible spaces that foster the use of multiple learning strategies. Students learn best in environments where they are actively engaged in proving their learning, testing it through experimenting, collaborating and sharing it with peers, and finally reflecting on their knowledge to achieve effective interactions between learning and soft skills such as computational thinking (Freiman et al., 2016). This leads us to investigate the process of computational thinking in a new learning and teaching context where complex problems are solved in a more efficient way (Barr & Stephenson, 2011).

Even though the term "computational thinking" is still unclear, Wing (2006) defines it as thinking skills required in solving complex computational problems. For Berry (2015), computational thinking consists of solving problems by drawing on a variety of concepts used methodically by the means of a range of approaches

(Figure 2). Chiasson and Freiman (2018) proposed the model of the computational thinking process consisting of four steps required to solve a problem during a programming activity: Perception, Decision, Execution and Feedback. During the perception of a problem, students investigate it through observations, analysis and evaluation while reflecting on previous knowledge to better define it. Afterwards, they decide on establishing a plan to solve it. They then execute their decision by using concepts and approaches of CT while receiving feedback on the outcome of their decision. The success of the computer challenge, based on observations, is in itself a feedback validating the acquired learning. However, if feedback is negative, they go back to previous steps to further investigate the problem by consulting other resources or applying other concepts and approaches. When a solution is found, Chiasson (2019) mentioned that students share it with peers or the teacher, thus, according to Kersh (2016), validating their learning.

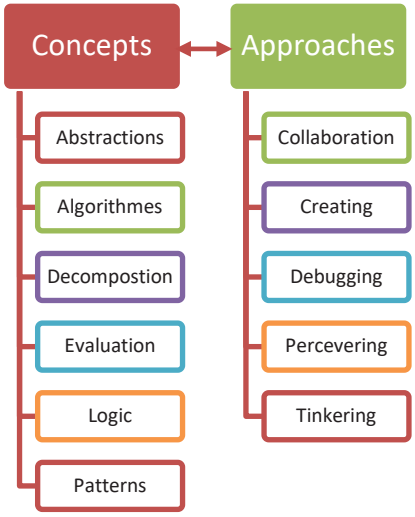

Figure 2. Concepts and Approaches of Computational Thinking. (Source: Chiasson & Freiman, 2018).

Modes of inquiry, data sources, and methods of analysis

This case study approach is an interpretive qualitative research (Van Maanen, 1983) allowing conceptual categories to inductively emerge from collected data during a thematic analysis (Paillé, 1996). Two groups of students n=44 (24 in Grade 6 and 20 in Grade 7, for whom we have obtained parent consent) from a middle school in New Brunswick, Canada participated in the study. To gain deeper insights into the students' experiences with tasks, 12 groups of students were randomly created (Grade 6 and Grade 7). Data collection took place during 10 one-hour sessions in which we conducted semi-structured interviews (after each session), field observations and digital traces. Data analysis was conducted in two stages. First, each of the 10 interviews were transcribed and analyzed with video observations to identify elements of the computational thinking process for each task they were solving. During the second stage, following a grounded theory perspective (Glaser & Strauss, 1967), a within-case thematic analysis created conceptual categories identifying characteristics of the learning space that contribute to the process of computational thinking thus refining the initial model (Chiasson, 2019) (Figure 3).

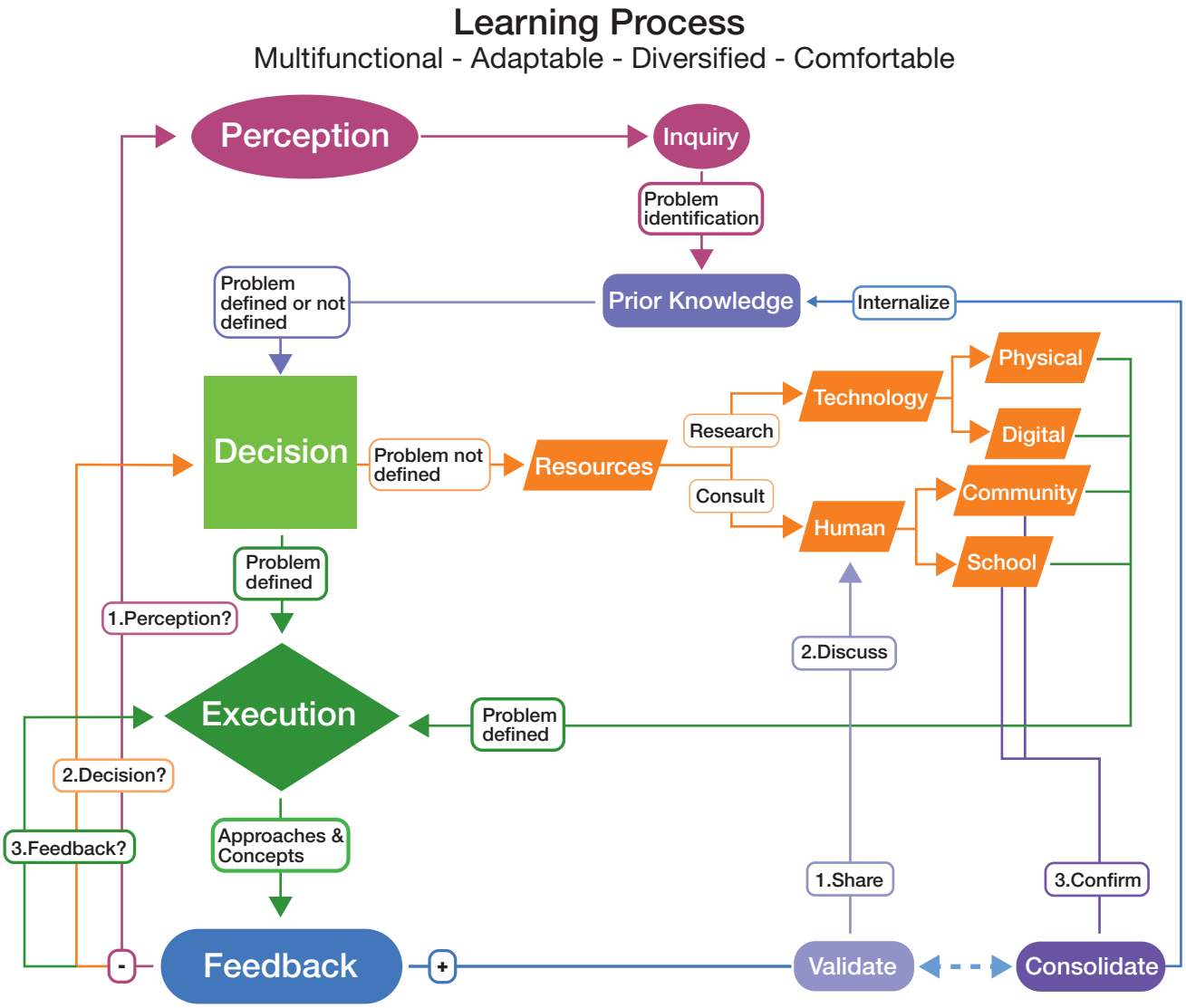

Figure 3: Process of Computational Thinking Refined. (Source: Chiasson, 2019).

Results

In relation to the first research objective, findings are presented in three distinct phases representing the workflow of the challenge students were asked to create, experiment, validate and share. In the design phase, students in teams of two started by clarifying and articulating the parameters of the task. All the challenges created consisted of programming robots to navigate in a labyrinth. To design the track of the challenge, while most of the teams used the two whiteboard creative walls, one group used the iPad and air-played their screen with creative apps.

During the experimentation, the teams created lines of code referring to the robot's path constructed on the floor. Most teams used a step-by-step approach to experiment with their lines of code in order to make changes as the project progressed. All students reported having relied on their observations to detect problems that occurred during the execution-validation phase. One participant explained: *"So when it messes up, you see what it does and you change that (line of codes)."* In fact, their observations prompted many questions, engaging them in inquiry to identify the nature of the many problems they encountered. Trial and error was the most popular approach used by the students for problem solving. As one participant states: "*We are doing a lot of testing, yeah.*"

When sharing their findings with their classmates, all teams admitted to having fun doing this learning activity and recognized the importance of putting a lot of effort into solving problems. They learned that problems could be solved with more than one method. While they all acknowledged worry and frustration with the problems they faced, everyone expressed their determination and perseverance to solve them. They admitted to experiencing a sense of relief and pride on accomplishment. Finally, students perceived the computer challenge as a positive and engaging learning activity they would like to repeat. As one participant puts it: *"Challenges are hard and it is a relief when you done it and you get to do more. I want to do more when I get one done and keep doing it."*

Related to the second research objective, we identified four broad characteristics of learning spaces that could enhance the process of computational thinking: multifunctional, engaging, diversified and comfortable. A multifunctional space allowed students to configure and reconfigure the space (mobile furniture) supporting the multiple functions of their challenge (designing, creating, experimenting, etc.). In fact, the ease and rapidity of transitioning from one activity to the next such as creating, experimenting and presenting reflected the mobility of the furniture as well as the affordances of a technology-rich space including digital and physical technologies. Results also show that an engaging space motivated students to participate in their learning by collaborating and receiving feed-forward feedback to validate their learning. Moreover, a diversified space provided students with meaningful choices in the tools and the methods used to accomplish their challenge, thus answering to everyone's needs and learning styles.

Our second goal was to capture experiences of teachers and have some preliminary results in terms of the classroom adaptability and the transformation of their pedagogical practices. Both teachers mentioned their satisfaction in regards to their new learning space. Even if it wasn't hard to adjust, they indicated that it took a bit of time to adapt. Teacher 2 states: "*In terms of adjusting, I wouldn't say it was hard, but it does take some time to get used to."* He added that, compared to a traditional classroom, it is easier to manage students working together because of the mobility of the furniture: "*Now, with this mobility, you can ask certain students to wheel themselves to another."*

Both teachers indicated that the mobile furniture sheds a new perspective on collaboration through the ease of movement giving students freedom to work with others. Teacher 1 mentioned: "*I think the new furniture open up a whole new thing about cooperating together because that way they can move very freely in the class and makes it so easier for them to move and work with whom they want*."

This new learning space provided opportunities for teachers to teach differently. In fact, the teachers placed themselves in the middle of the classroom which seemed to be an effective and efficient way to interact with students. Teacher 2 explained:

> *"My desk is the middle of the class cause it's quite central. I can swivel, I can pivot, I can hear and they can hear me better. They have access to me from every angle. Whereas if I was at one corner, then students are too far away. In the middle, everybody is equally distance from me or equally close. I think that I find that being central is cool place. It is very easy for them to wheel back to where they were without you noticing all the time."*

On the other hand, he added that this loss of control over the students took some time to adjust to. He stated: "*It takes away from that control and it takes some time to get used to*."

Results show that teachers recognized the benefits of offering students choices in how they work and learn. This learning space engaged students in owning their learning in a responsible manner. Teacher 2 cited: *"So, I think it certainly interests students in completing their task cause the students have the choice of choosing how they want to complete the task. It gives them a sense of ownership and responsibility."*

On the purpose of assessment, the teachers appreciated the freedom of movement allowing for better use of the affordances of technologies to collect data, making it easy to give effective feedback to students. Teacher 1 explained:

> *"As a teacher you are always assessing, summative and most of the time formative. This environment makes it so much easier walking around the classroom. When you have the audio system (with pods), whiteboards, digital platforms (iTunes U)...you have this input of information that consistently comes in, so it is easy for you to formatively assess on the go and students do not make the same mistake as they go."*

Conclusion and Discussion

Our preliminary results seem to indicate that learning spaces that are multifunctional, engaging, diversified and comfortable can potentially contribute to the process of computational thinking. Using the affordances of technology-rich environments, students have the potential to solve complex problems. In a student-centered environment, students can conceptualize, create, build, experiment, validate and share their knowledge (Freiman et al., 2016).

The process of computational thinking will benefit students in solving real world problems (Brennan & Resnick, 2012). In modern society, schools can no longer learn and teach in traditional classrooms, thus the urgency to take into account the four characteristics of learning space that enhance the process of computational thinking. Besides bridging the gap between formal education system and innovative society, this study will guide the education system on how to inform leaders and most importantly teachers on the features of those learning spaces to maximize its pedagogical possibilities. Through this study, new direction has emerged in areas needing further exploration such as the fluidity of transitions and movements within the space. Can learning space increase teacher and student efficacy in their work, thus reflecting practices of the innovative society?

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Professional collaboration in teaching teams - sharing students, space and time

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Abstract

I argue that successful teacher collaboration is dependent on utilising the transparency and the openness of modern learning environments, as well as teachers' working hours, in a team organisation. My ethnographic study explores how, by observing each other and executing activities together, teachers incorporate peer learning as a natural professional development, which supports their practices both as individuals and as a team. I analyse how the community of practice develops within the team when they are supported by the school management and trusted with autonomous organisation. In typical educational environments, which are often based on a classroom structure where teachers are individually distributed between the rooms, it is rare to experience deep collaboration amongst the teachers (OECD, 2016; Schleicher, 2016, p. 29). Transitioning to modern learning environments could be a key to unlock deep collaboration and joint commitment within teacher teams.

Keywords

TEACHER COLLABORATION | LEARNING SPACES | AUTONOMY | ETHNOGRAPHY | OBSERVATIONS

Introduction

This paper explores how teachers working in a team share the responsibility and use of space and time in order to create a good learning environment. During my research, I discovered that teachers' physical movements and their engagement in shared activities for and with the students support collaboration in the teaching team (Broens, 2018). Teachers, who share and use a space at the same time, are likely to collaborate, because they have to negotiate and coordinate their use of it. They spend more time on planning how to use the space together and how to work together when executing learning activities. Optimising the learning situation for the students becomes a joint task.

The starting point for this paper is a field study consisting of 300 hours of observation of a team of six teachers, responsible for 180 students in year 5 and 6 (11- to 12- year-olds) in a shared open plan learning space in Australia. This is supplemented with data from observation studies conducted in schools in the Netherlands, Spain and Denmark. These are exciting times for educational research involving physical spaces as the field is developing globally, both within research and in the practical field, where many schools are being built or refurbished to have alternative and/or additional learning spaces to the classroom. The spaces in which I did observations are designed as collaborative environments for students as well as teachers. I chose these schools because they are well known in their countries for being successful in changing their physical environment to

support their pedagogical intentions (Calvo, 2015; Fibæk, 2006; CEFPI, 2012). The research and understanding presented in this paper is based on my ethnographic studies in various schools in the above mentioned countries, however, all the examples used are from the ethnographic research in the Zone, the learning space in the Australian school.

For the purpose of this paper, in order to explore the development of and within a teaching team, I have chosen to work with three main concepts (1) Community of practice (Wenger, 2004), (2) Joint commitment (Amit, 2012), and (3) Foucault's (1975) idea of disciplining people through time scheduling and space planning. My perspective is that everything is socially situated and that development occurs in the interaction between people and between people and objects.

A TEAM OF TEACHERS

A community of practice is characterised by a) shared domain of interest, b) engaging in joint activities and interests; and c) being made up of practitioners who develop shared resources (Wenger, Wegner, 2015, p. 2). I find these characteristics applicable for a team as well; however, I define a team more narrowly as a group of people joined to achieve a common goal. Contrary to a group, the members in a team are seen as interdependent because they work jointly towards a goal, complementing each other's weaknesses and maximising their strengths. They are accountable for the work collectively, as well as co-responsible for all outcomes involving the team. Wenger (2004) argues that communities of practice are anarchistic by nature and thus cannot be controlled. Instead of controlling them, it may be possible to manage them through design (systematic, planned and thought out colonization of time and space). This thinking is fundamental for understanding the dynamics around a community of practice and I find that it, likewise, is essential to understand teams consisting of teachers.

WORKING AT THE SAME TIME

Educational environments have a long tradition of teachers teaching and preparing lessons in solitude. Thus, it is often considered irrelevant when and where the preparations of the learning sessions take place. However, as Wenger (2004) proposes, a way to manage communities of practice is through systematic and planned colonization of time and space, which makes it important where and how the teachers spend their time.

IN THE SAME SPACE

In order to investigate how teachers can use and share a space, it is important to explain that by *sharing a space* I mean using or occupying it jointly with others. It means that a shared space is not yours, nor mine, but ours. This definition is inspired by Amit's (2012) definition of 'joint commitment' which she uses as a strategic point to investigate what happens in a community when a commitment does not belong to the individual but is shared amongst collaborators.

Negotiation

When the teachers are jointly committed to make a learning session, everyone engages in and contributes to the working and learning environment. Tasks and roles are distributed in the most reasonable way for the situation, not for the individual. Coherent pedagogical practices are needed within the teaching team both in regards to academic tasks and student behaviour. Rudimentary social discipline is an important part of any educational system that is organised in larger groups (Foucault, 1975), and it is important to keep focus on professional reflections of what is beneficial for a supportive learning environment instead of personal preferences amongst the teachers. In open spaces, 'a mature system indicated by coherent pedagogical practice' can only emerge through negotiations over time (Deed and Lesko, 2015, p. 229). Negotiations between team

members are important for the team community because this active participation is a way to identify as part of and with the team (Wenger, 2004, p. 200). Once you identify as part of the team and engage in a joint commitment, disagreements are harder to ignore (Amit, 2012). Thus in order to develop and maintain coherent pedagogical practices, it is important that the team spends time together both when planning and discussing pedagogical approaches and during activities with the students.

Planning

Sharing a domain of interest and showing commitment to it is an important part of being defined as a community of practice (Wenger-Trayner & Wenger-Trayner, 2015). A good example of designing circumstances for that is the creation of the Zone (the open learning space in the school in Australia previously mentioned). When the school management decided to create the Zone, a part of the concept was that a teaching team of six would be assigned to the students and the space. Not only during learning sessions, but also when planning, preparing and evaluating. The teachers have full autonomy to plan the learning situation and environment within the Zone as long as they do it as a team. In order for the autonomy to be complete, the teachers working in the Zone do not have any other responsibilities at the school.

While the day-to-day in a shared learning environment can seem like a natural flow of activities to most students, parents and visitors, the scheduling that is needed to make it work is elaborate. A team's joint commitment during the planning stage, where all subjects and learning activities are shared and discussed in relation to the flow of the learning sessions, can ensure a progression through the activities and lessons.

The planning process in the Zone is comprehensive and important and the team meets every morning to go over the plan for the day before the students arrive. I observed that the morning meetings ensure that there is a platform where the joint commitment, present in the main planning stages in the beginning of each term, can continue throughout the year. Examples of decisions/activities characterising the morning sessions include: how to divide students into groups for certain activities, deciding which teacher should take the lead in the different activities or reminding each other of earlier decisions. Everything is open for discussion if any of the teachers have an issue with or have developed a better idea for something already planned for the day.

Throughout the day, an open shared space makes it possible for the teachers to spontaneously change the organisation if they find it beneficial for the students. For instance, if problems arise amongst the students, one teacher might offer to put aside what they had planned and incorporate more students into their session in order to let another teacher attend to the situation. When the team collaborates this way, it is a display of joint commitment and the students most often will not notice that there is a change to the original plan. The most opportune moments for teachers to communicate about making ad hoc changes to the program, is when the students are working independently on tasks not requiring a lot of assistance or when one teacher is teaching multiple groups.

Teaching together

Explicit teaching is still a central element in modern learning environments and when it is conducted for more than one group of students it provides opportunity for the teachers to observe each other 'in action'. It also frees up teachers to supervise from the perimeter, helping with student behaviour. More than one teacher can actively take part in the explicit teaching (introductions and explanations). Often the teachers on the perimeter will be listening to the teacher(s) at the front and ask questions or give additional remarks, improving the explanations. The above are examples of how to incorporate peer learning into the day-to-day. According to Bridwell-Mitchell (2016), peer learning is one of the drivers behind professional collaboration.

In the Zone, I observed how the teachers naturally utilised the observations of each other's practices in their discussions. The observations contributed to the general knowledge they possessed about each other's skills and possible practices within the team and sometimes concrete examples were used to qualify a discussion. When the teachers focused their discussions around a learning activity instead of on the groupings of students, they were more involved in coordinating the use of space; collaborating in order to provide the best opportunities for the activities they were planning. Utilising the openness, they would free up teacher resources and allow group sizes to fluctuate more naturally, making it possible for both teachers and students to retreat to more private spaces when needed.

Transitioning into a modern learning environment

Deed and Lesko (2015), who have studied teachers' adaptation processes when moving into an open school building from a traditional one, point out that teachers most likely are at different stages of understanding of how to use the space effectively. In the Zone there is a wide range of personalities with very different approaches towards the use of the spatial setting. For one of the teachers, Wayne, it took a long time to adjust to the open space, while it seemed like the most natural thing for other teachers in the team. Wayne described his initial skepticism towards the open plan and explained how working in the space with a teacher he trusted helped him to adjust and come to like it.

The different approaches towards a space can be the source of fun and/or frustration, which requires understanding and coordination when sharing. It is relevant to notice the teachers' different approach to the space because their approach influences how they interact with students and the other teachers. The differences between the teachers' personal characteristics and practices also become more obvious when they share a space, than when they practice separately in classrooms. Wenger (2012) describes that community of practice thrives on tension and interaction between diversity and homogeneity. In order to avoid friction between habits and possible practices, there is a need for a continual process of negotiation between the teachers (Deed & Lesko, 2015). The behaviour of the users is, amongst other things, influenced by their sense of affiliation with the other users and with the space. Both Wenger (2004) and Amit (2012) argue that a sense of belonging can be unequally distributed amongst members of a community. According to Wenger (2004), when a member participates in the negotiations of meaning within the community, it enhances their feeling of belonging, which in turn influences the understanding of their own identity. He points out that negotiation of identity is constant both for the individual and for the collective. Some users might feel a larger association to a space because they use it more or because they are more involved with the decision making concerning that space. In Wayne's case his teacher identity and practice changed during the time he worked with the trusted colleague and he does not want to go back to the more closed and isolated structure of the classroom. Wayne is aware that the open shared space is not his most natural working space and that it is important for him to be assigned to different areas within the space or he risks being 'boxed in again', despite preferring the benefits of working in a team in the open space. The interdependence of the users is a relevant point of joint commitment, because it is harder to be indifferent with issues or people you depend on (Amit, 2012). Sharing a space means that everyone using it cares about how it is set up and treated.

Summary

I wanted to explore how teachers in teams share the work and responsibility for the students through their use of physical space and time, in order to understand why some teams achieve successful deep collaboration. The leadership at the schools managed their educational environments through a design that encompasses the teachers' time and space. Foucault's point of view is that timetables and collective training is used as a way to control and monitor people. This perspective might be one of the reasons other schools generally refrain from introducing this culture amongst their teachers as the cultural history dictates freedom from oversight. However, making teachers collectively responsible for a group of students in a team that, in return, has autonomy and opportunity for peer learning (daily professional development) seems to be a good basis for collaboration. Demir (2015), who investigated the effect of organisational trust in relation to teacher leadership in primary schools, found that the environment should advocate autonomy if strong relationships are to be formed. Schools with focus on the professional development of the teachers ensure an environment where teachers support one another.

The shared open space, time and students are a catalyst for teacher collaboration to take place in the moment. The teachers confer, exchange, discuss, evaluate and decide in real time during the learning session. Coherent pedagogical practices are ensured through teachers negotiating how best to execute their joint learning activities and develop shared resources. The teachers can utilise each other to understand and develop their habits and professionalism. Their different approaches to and stages of understanding how to use the space is an asset for their collaboration because a team's development thrives on the tension and interaction between diversity and homogeneity. A team made up of individuals, whose personalities together represent diversity, various perspectives and opinions while still finding grounds for agreement, have the possibility of being a successful community of practice.

Acknowledgements

I would like to thank De Werkplaats, Collegi Montserrat and especially the teachers in the Zone at Northern Beaches Christian School for sharing their daily professional lives with me. This paper is mainly based on the research I did for my master thesis at The Danish School of Education, Aarhus University.

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Empowering teaching teams: An essential factor in the success of innovative learning environments

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Abstract

The innovative learning environment (ILE) is characterised by shared multi-modal spaces, absence of walls, ubiquitous technology, and adaptable furniture. Student deep learning in an ILE is supported by innovative teacher practices. The ILE challenges the egg-crate model of school design, characterised by separation of classes, teachers and subjects. The ILE is enabled when these elements are mutually shared. The enduring effectiveness of the ILE for student deep learning is considered reliant on the capacity of teachers to work as a team, potentially challenging long-held beliefs of teaching as a solo profession. This multiple case study presents a number of implications for the successful development of teaching-teams in ILEs. These include adapting pedagogical approaches and enabling supporting systems in the shared space, the significance of collective teacher efficacy, stages of team development, and leadership effects – of both the teaching team leader, as well as the leadership that the principal models to the community.

Keywords

TEACHING TEAMS | *COLLECTIVE TEACHER EFFICIENCY* | *SCHOOL LEADERSHIP*

Introduction

The traditional egg-crate classroom has been the context for teacher practice, which is described as autonomous and spatially private. Upitis (2004) suggests that the traditional classroom design plays a role in preserving the 'transmission model' of teaching. It presents fixed utility, reinforces teacher-centred pedagogy, restricts student agency and is insufficiently equipped for collaborative teacher practices (Campbell, Saltmarsh, Chapman, & Drew, 2013; Dovey & Fisher, 2014; Martin, 2002). It is not suitable to shoe-horn the activities of the traditional classroom into ILEs designed as "spaces that afford polysynchronous learning" (Charteris, Smardon, & Nelson, 2016, p. 14).

The challenge facing professional practice in school education to become both collaborative and proximal may be achieved through a deliberate focus on the teaching team in the ILE (Bradbeer, 2017). In this paper, the effectiveness of the opportunities afforded by ILEs for student deep learning is considered from a number of perspectives: teachers' capacity to learn, grow and adapt their pedagogical practices; the support systems; the significance of collective teacher efficacy; stages of team development; and leadership effects, of both the teaching-team leader, as well as that which the principal models to the community. These elements – the ILE, teacher change, teaching teams, and leadership—will be briefly discussed in turn and form the basis of the research that follows.

INNOVATIVE LEARNING ENVIRONMENTS

An innovative learning environment (ILE) is considered an ecosystem, "an organic, holistic concept that embraces the learning taking place, as well as the setting" (OECD 2013, p. 25). It is suggested that ILEs contain a number of material and design elements, including multi-modal and technology-rich learning environments, flexibility in the potential use of space, and adaptability of furniture. These elements are intended to support a range of human activity which may include:

- Student agency,
- Integration across curriculum areas,
- Multiple teachers working as a team, melding their collective expertise, and
- Teachers adapting from solo to team-based practice.

(Deed et al., 2014; Bradbeer et al., 2017)

In particular, it is the last two activities listed that relate to the research presented here, that shows evidence that the ILE not only supports but enhances the practices of teachers. ILEs offer the potential to release the lid on the possibilities of student learning and see increased levels of engagement than the traditional classroom may afford. (Byers, Imms, & Hartnell-Young, 2014; Halpin, 2007; Woolner, Clark, Laing, Thomas & Tiplady, 2012)

TEACHER CHANGE

It is attributed to futurist Alvin Toffler as saying, "The illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn" (BBC News US & Canada, Retrieved: http://www.bbc.com/news/world-us-canada-36670572). This capacity to 'learn, unlearn and relearn', is part of the process change as teachers begin "to see the potential benefits that greater geographic freedom could bring to the learning situation" (Cleveland, 2016, p. 43). These changes in perceptions - learning, unlearning and relearning - are considered crucial in the transition from teacher-directed to learner-centred pedagogies. Pedagogies are "specific configurations of teaching and learning in interaction . . . [and the] shift towards learner-centred pedagogies is part of a larger change toward expecting higher levels of educational attainment" (Paniagua & Istance, 2018, p. 20). Learner-centred pedagogies have been aligned to inquiry-based approaches, encompassing collaborative learning, where the learner takes an active role, and as a result a positive difference in the teacher-student dynamic may develop (Dole, Bloom, & Kowalske, 2016).

Teacher efficacy relates to the teacher's own beliefs concerning influence on student achievement, and when it is collectively held there are increased benefits to student attainment and increased confidence evident in the teachers (Goddard, Hoy, & Hoy, 2000; Hattie & Zierer, 2018). In supporting the effectiveness of teaching teams, strong collective teacher efficacy may actively underpin student success in an ILE.

TEACHING TEAMS

It has been found that teams are unable to reach a high level of collective efficacy merely by gathering as a group, or by leadership decree, but rather progressing through the stages of forming, storming, norming and performing (Fisher, Hunter, & Macrosson, 1997). These stages initially outlined by Tuckman (1965) and the focus of research by Largent (2016), found that "the Tuckman model can be a good tool for teaching and monitoring team development" (p.6-22). These stages consider that time and support play a significant part in the development of effective teams.

When growing teaching-teams, Quintero (2017) found that "collaborative school cultures and professional relationships don't just happen by chance, instead they must be facilitated and nurtured" (p.20). In addition the shift to group-based pedagogies in ILEs require teachers to tailor a suite of mindsets and skills for working as a team, such as empathy for others in proximity, negotiation, collaborative expertise, interdependence, and

adaptability (Alterator & Deed, 2013; Campbell et al., 2013; Deed & Lesko, 2015; Lukacs & Galluzzo, 2014; Meirink, Imants, Meijer, & Verloop, 2010). In addition to this, Saltmarsh, Chapman, Campbell, and Drew (2015) found that making use of the space as a learning resource requires emphasis on the idea that the teachers and students can learn together, while de-emphasising structural elements of timetables and routines.

LEADERSHIP

Strong leadership is critical to creating the desired culture within the school community, as it both promotes and sustains change, while ensuring an atmosphere that is founded on trust and collegiality (Hattie, 2012).The leadership style can make a difference to effectiveness of change as teachers respond more favourably to leaders identified as 'initiators'. These are seen to communicate a strong vision and articulate strategies for change (Baglibel, Samancioglu, Ozmantar, & Hall, 2014).

The Study

PILOT STUDY

The multiple case study, which is the primary aim of this paper, was informed by a pilot research project that sought to identify barriers teachers faced in utilising the opportunities of ILEs for student deep learning. Yin (2014) suggests that pilot studies enable a unique test of the research question propositions, "whose purpose is to identify the research questions or procedures to be used in a subsequent research study" (p.283). An exploratory single case study was undertaken in the form of a workshop for a small group of teachers from the same school.

Utilising a game format, the workshop presented a range of questions for the teachers to reflect on their transition to an ILE. The most frequently mentioned barrier related to the teachers who were working in proximity in a shared space yet were not perceived to be working as a team with other co-located teachers. They were not, as it was said, "on the same page" (Teacher 2, Pilot Case Study) and it was noted that practice and mindsets seemed resistant to change. In practical terms, teachers in the workshop expressed frustration when furniture had been used by colleagues to permanently divide the space, or members of the team were closed-minded to collaborative practice.

Multiple Case Study

RESEARCH QUESTION

The pilot study framed the next phase of research seeking further clarification on the barriers and challenges of teachers adapting practice in ILEs, with an emphasis on the effectiveness of teaching teams. The study responds to a single research question: *How might teachers be supported and equipped to adapt their professional practice to fully utilise the opportunities for student deep learning in the innovative learning environment?*

RESEARCH DESIGN

The multiple case study sought to replicate the logic of the pilot study, focusing on teachers as the unit of analysis, specifically those co-located in a shared learning space. Sampling focused on teachers in teaching-teams in an ILE that had demonstrated adaptation of pedagogy in the multi-class environment and team-based practices.

Based on this criteria, three schools were approached, and the principals and teaching teams agreed to participate. For the purpose of confidentiality, the schools are called The Coast School, The Forest School, and The Lake School. Across these schools, four teaching teams participated. Three of the teams were within primary schools and one was within a high school. Two teams consisted of two teachers, one team had four

and the remaining had five teachers in the team. Two of the schools had purpose-built ILEs, while the other learning environment was a refurbished space in an older building. There was a range of teacher career stages represented in the study.

The data collection involved observing teaching teams, the teachers' activity and interactions with students and each other. This was followed by a focus group with each team and a semi-structured interview with the principal.

FINDINGS

Vision and Leadership: In each school, the principal and the teaching team articulated the vision and intention regarding the purpose of ILEs in the school. One principal mentioned that the ILEs in the school facilitated a positive shift toward future focused approaches to learning by supporting a diverse range of student needs through different group structures.

Two of the school principals specifically mentioned the importance of a flattened leadership structure, rather than the implied traditional hierarchical leadership approach, as being key to empowering teachers to adapt their pedagogical practice and feel supported. The identification of team leaders facilitated communication and was crucial to the vision and intention of ILEs being realised by the team. "Communication is massive" (Carol, The Coast School) and "we're constantly in dialogue. . . we need to be so organised" (Robert, The Coast School). Leadership at the team level was expressed in mentor-mentee relationships. This meant that team dynamics focused on their capacity to share practice and work together, "I think our model of mentorship, older person, younger person, as well as team teaching – we have complementary skills – is really cool" (Paul, The Forest School).

Time for planning: A common factor amongst the teams was the value of having considerable chunks of time for collaboration. Teaching teams were allocated time for planning, and building trust and connection as a team, rather than just the 'doing' of teaching, "spending time on team building and allowing people to learn together to build confidence in each other" (The Principal, the Lake School). The collaborative nature of the team was reinforced when professional learning was also prioritised as a shared team experience.

Shared norms and systems: Much of the scheduled team meeting time was spent creating and embedding shared norms and systems that would support pedagogy. The team at The Forest School, who teach secondary music, liken the culture in the learning environment to 'showbiz', explaining, "there's no greater system than putting on a concert. . . everything is structured in a way that fosters something beautiful" (Paul, The Forest School). He explains that having systems in place is important to enable creativity. At the time of the observation, a pre-service teacher was present and remarked that "the space is crucial. . . the way the class is structured, with a rotational lesson, within the class . . . requires a space like this" (Richard, The Forest School).

Each team appreciated the importance of establishing shared values and understandings. There were collectively held norms for open dialogue, positive problem solving and resolution strategies, which they felt had a positive impact on the students. "If the kids know you're not going to support each other, they won't be interested either." (Lisa, The Lake School).

Consistency of systems within the ILE is supported by other shared norms, including language and terminology. At The Coast School, one teacher explained that in the teaching team the term 'learning' is used instead of 'work' and 'space' instead of 'classroom'. The shared understandings are also considered important in establishing the overall culture of the space, especially the messages received by students. The teachers are aware that in an ILE they are constantly modelling collaborative behaviours to the students.

Pedagogical approach: Each team highlighted inquiry-based learning, or specifically mentioned project-based learning as a pedagogical approach, exploiting the multi-modal possibilities of the ILE. As a relatively new school, The Lake School, has deliberately concentrated on a particular model of inquiry-based learning as a whole school focus. The principal at The Coast School supports teams to take ownership of the inquiry learning process by empowering teachers to design the learning together, and this encourages a culture of trust and autonomy.

Discussion and conclusion

The idea of the teachers being 'on the same page' resonated with each school as they discussed the value of the team approach, and it was specifically mentioned by a teacher at each school as an important marker of success for teaching teams. This research has indicated that the 'same-pageness' of teachers may be sustained by:

- School leadership providing clarity of vision and intention of ILEs for student learning
- Positive team dynamics, shared norms and systems
- Supporting teachers through providing time to plan and opportunities for shared professional development

To reinforce the last point, ongoing professional development is critical, as Cleveland (2016) notes, "Teachers require ongoing professional learning support if they are to adopt constructivist pedagogies and make the most of the innovatively designed learning environments" (p.46). Collective teacher efficacy could be summarised as 'better together', from the observation of each team it was evident that there was a strong connection amongst team members which was valued and nurtured.

The idea of teaching in teams, co-located, collaborative, and connected is reinforced as a critical consideration for effective practice in ILEs. The next terrain that requires both navigation and negotiation, to employ the terminology used by Bradbeer (2017), can be focused on utilising data to strategically and systematically grow capacity of teaching teams in innovative learning environments through ongoing professional learning and support that will embed change.

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Real-time locating system in innovative learning spaces

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Abstract

Three recent developments have created new opportunities to examine learning in physical spaces. First, there has been a resurgence in interest in creating more varied spaces for learning, both in schools and informal learning spaces. Second, technologies have been developed to make interior real-time location tracking more accessible. Third, the rise of learning analytics promises higher fidelity examinations of learning. In this pilot study, we examine learner activity in an innovative learning space by using a real-time locating system (RTLS) to record learner movements around an educational technology exhibition. RTLS data has the potential to support the understanding of users' preferences and engagement with objects in an open learning space, and we examine whether RTLS data on time spent near learning objects might mirror data from more conventional survey responses regarding participants' interests in exhibition objects. Such data can help facilitators to support self-directed learning activities in innovative learning spaces.

Keywords

INFORMAL LEARNING SPACE | LEARNING ENVIRONMENT | EDUCATIONAL TECHNOLOGY | REAL-TIME LOCATING SYSTEM | SELF-DIRECTED LEARNING

Introduction

The innovative classrooms of today are generating new possibilities for examining the impact of physical space on learning. While traditional classrooms with rows of front-facing seating made efforts to examine student attention and engagement literally straightforward, as in checking to see if students were looking straight ahead and even in extreme cases monitoring the position of their feet, next generation classrooms call for new research approaches as the elements of the no longer static physical environment themselves become variables of interest.

But, of course, classrooms are not the only learning space of interest. Learning is not and should not be confined to schools. Open learning spaces such as libraries, museums and community centers play significant roles in facilitating authentic learning. With rich real-world references, these venues engage learners in diverse topics and inquiry through conversations and dialogues. In the case of informal science learning spaces such as museums and community labs, learners "experience excitement, interest, and motivation to learn about phenomena in the natural and physical world," and "think about themselves as science learners and develop an identity as someone who knows about, uses, and sometimes contributes to science," which are two distinctive science learning aspects differentiating these out-of-school learning environments from traditional classrooms (National Research Council, 2009, p. 31).

Recent technological advances have created exciting learning opportunities in informal and innovative learning spaces. Digital media and technologies are used as content, hook, or outreach platforms to enrich youth learning in the next generation classrooms, libraries, museums and afterschool spaces (Herr-Stephenson, Rhoten, Perkel & Sims, 2011). Customized visitor tags (such as RFID tags) with partner web portals allow museum visitors to bookmark and archive learning content that is related to exhibitions for later reference online (Hsi & Fait, 2005). Interactive technologies and media further enable participatory exploring and learning experiences, and create environments and atmospheres that immerse learners into the world of various exhibitions (Ziegler, 2015).

Among the recent technological developments in this field, real-time locating systems (RTLS) have become increasingly popular and are predicted to be more widely adopted in informal learning institutions in the next few years (Freeman, et al., 2016). There are many possibilities with RTLS in innovative learning spaces, and more research on this emerging development remains needed. In this pilot study we explore the following questions:

- How can RTLS data provide insights into learning in innovative spaces?
- What can educators/facilitators learn from RTLS analytics about learners?
- How might RTLS data facilitate learning in innovative learning spaces?

We aim to explore the potential of RTLS as an open technology platform for understanding learning activities in open learning spaces.

Theoretical Perspectives

Digital technologies and online learning resources have transformed learning and where it happens. Learners today not only gain knowledge at schools, libraries or other offline information centers, but also through online communities and spaces. The latest digital technologies (e.g. virtual reality, MOOCs, the Internet of Things) offer new learning possibilities, and challenge educators and researchers to design and define comparable physical learning experiences. One important dimension behind all these developments in technologies that deserves further investigation is spatiality and learning. How do technologies change spatiality? How do these changes in spatiality shape and/or limit learning experiences?

Spatiality as the focus for social science and educational research is not new. Soja (1989) contended that there exist "dialectical relationships between bodies, time and space" and explained that "social practices produce space just as space produces social practices" (Jones et al., 2014, p. 1129); it is important for a "spatial turn" in social theory. Jones et al. (2014) argued that while some education researchers have made such a spatial turn in research orientation, "educational practice remains predominantly grounded in a narrative of time and history (consider developmentalism, organizing education by age and for specific periods of time, emphases on "time on task" and "progress," predicting students' potential based on past performances, etc.)" (p. 1129). More educational research is needed on how various spaces can facilitate or constrain various learning approaches.

For the past half century, the focus of educational technology has been on computers represented by keyboards and screens. However, the latest technological innovations in various fields, including material, mechanical and electrical sciences have enabled new educational technologies that go beyond keyboards and screens. Full-body interfaces create more natural and tangible ways of interacting between learners, devices, objects and learning environments (Eisenberg & Pares, 2014). These tangible and full-body interfaces facilitate computationally enriched spaces that encourage movement in various types of learning activities. These technologies also contribute to the study of embodied cognition in learning (Eisenberg & Pares, 2014). From the theoretical

perspective of embodied cognition, physical materials and objects are embodied foundations and provide intuition and metaphorical insights for understanding abstract concepts when thoughtfully employed. In Papert's (1980) words, physical materials can act as "objects to think with" in learning.

In addition to full-body interfaces, rapid development of wireless, mobile, and sensor technologies also contributes to ubiquitous learning (Chin & Chen, 2013; Wang, Liu & Hwang, 2017). Ubiquitous learning (u-learning) is a concept that describes learning contexts where learners access educational resources anytime and anywhere. In u-learning environments, sensors and computing devices are embedded and integrated into daily objects and tools. Learners can immerse themselves fully into different learning situations seamlessly, and fewer interventions and interruptions would occur as learners move among various learning spaces and environments. Furthermore, the context-awareness feature of u-learning enables just-in-time learning resources for learners based on real-world contexts. Combining learner profiles and learning analytics from various learning platforms, an ideal u-learning system can provide personalized learning services.

Location is a key parameter to enable tangible and full-body interfaces as well as u-learning environments, and RTLS is one such emerging technology for these innovative learning opportunities. Radio frequency identification sensors (RFID), a component of one popular RTLS, can be used to detect the proximity of tagged objects. This proximity information can then be used to program interactive, customized and/or personalized learning or exhibition experiences for learners. With location intelligence and contextually relevant information, educators can provide dynamically customized information based on where learners are in the learning environment. Combined with temporal data, the temporal-spatial, contextually aware data can be used to generate meaningful learning analytics that will give real time feedback to both learners and educators on their learning (Jaebker & Bowman, 2015).

Research Context

This paper presents an early-stage pilot test of RTLS at the Smith Learning Theater at the Gottesman Libraries at Teachers College, Columbia University. The Smith Learning Theater is an experimental environment that can be configured and curated to support a diverse range of learning, teaching, and research activities (Costello, Chae & Natriello, 2015). Library staff members partner with event sponsors to create ambitious settings to optimize learning experiences. The Learning Theater features a wide range of reconfigurable elements and allows event sponsors and participants to realize designs that cannot be achieved in typical settings. The theater infrastructure offers a robust set of tools and technologies that can be augmented over time to meet evolving needs of students and faculty. These tools and technologies include: video, audio and multimodal data capture, customized Internet of Things tools, data visualization, and reconfigurable and movable furniture pieces and instructional tools.

One of the featured tools is the Quuppa indoor positioning system (http://quuppa.com/). Unlike most RTLS that rely on the popular RFID technology to determine the proximity of tagged items, the Quuppa system tracks Bluetooth Low Energy (BLE) smart tags and devices with accuracy down to a few centimeters through a proprietary hardware, software, and online platform. The Quuppa system has been applied in various industries including healthcare, sports, manufacturing and retail logistics, and has potential in innovative learning spaces.

DATA COLLECTION

For this pilot test, we investigated how real-time locating tags might work with a relatively simple open-ended exploration in the Smith Learning Theater. Sixteen educators and educational technologists were invited to freely explore four STEM education apps that were presented on iPads around 4 stations at the theater. These

apps are: *Quiver, Spacecraft, Wikitude, and Just Science*. These apps were selected from a database suggested by Edtech professionals and educators for their relevance and/or strengths in STEM education. Each participant wore a Quuppa tag that tracked their real-time movement during a 20-minute free exploration session. At the end of the session, participants were asked to rank and recommend the apps of their preference for future review at a leading Edtech online publication *New Learning Times* (newlearningtimes.com).

DATA ANALYSIS

Our approach to data analysis, while managed by research personnel in this pilot, was designed so as to be amenable to full automation with further development. The movement data of each participant were recorded by the Quuppa server. The data were stored in JSON file format and processed using R. In order to understand how much time each participant spent at each station, and potential relationships between the time spent and their ranking of these four apps, we developed and applied a statistical method to process positional data. Gaussian Mixture Models (GMM) are very useful for analyzing two-dimensional data which may be clustered into groups such as that collected by a real-time locating system in an informal learning space. To estimate the parameters of the GMM we employed a Markov Chain Monte Carlo method of Gibbs sampling whose stationary state is the posterior distribution of the mixture model. This method applied to a frozen snapshot of the two-dimensional real-time location tracking data allows us to gain information about the groups, such as group membership, group location, and internal group dispersion, based only on the tag position data. Other algorithms such as k-means clustering may similarly cluster two-dimensional data but are non-parametric whereas Gibbs sampling is parametric (Ortiz-Vazquez, Liu, Lan, Chae & Natriello, 2017).

Using this method we were able to identify where most participants clustered during the free exploration session, and calculate each participant's time in close proximity to each station. Meanwhile, we also collected a simple, one question ranking survey from each participant. We assigned each ranking a score to calculate and compare the popularity of these apps. Ranking number one (the most highly recommended app) will be assigned with a score of four, ranking number two with a score of three, ranking number three with a score of two, and ranking number four with a score of one.

Findings and Discussions

Among the four apps, *Quiver* was the most highly ranked by participants (11 out of 16). Both *Just Science* and *Wikitude* are least popular based on the ranking scores. For the total time participants spent around each station, *Quiver* is among the highest, followed by *Wikitude*, *SpaceCraft* and *Just Science* (Table 1). Interestingly, *Wikitude* is not ranked as the 2nd on the recommendation list but does engage participants to spend more time around it (Table 2). Looking at individual participant's data, there exists a tendency that participants spent the most time at the station that they ranked highest (12 out of these 16 participants' station visiting reflect this pattern, as highlighted in the bold texts in Table 3).

Table 1. App Ranking Scores.

Application	Quiver	Spacecraft	Wikitude	Just Science
Ranking Scores	59	50	30	30

Table 2. Total Visiting Time by Participants at Each Station.

Application	Quiver	Spacecraft	Wikitude	Just Science
Total Time Spent by Participants around the Station (Minutes)	109.8	39.2	53	38.9

Overall, we found an interesting pattern between the time participants spent at their highest ranked station and the ranking they gave it (*Quiver* for most participants). In contrast, the *Wikitude* station presents the opposite pattern: it is ranked as the least popular among the participants, but participants spent the second most group time around it. Several participants anecdotally mentioned that it was a very confusing app, which could be one explanation for this phenomenon. The specific factors that contributed to these results are beyond the scope of this pilot test design. However, our pilot study demonstrates a new dimension to understand the process of free exploration in informal learning activities: in addition to the data from the self-reported survey, we are now able to gain temporal-spatial data on learners (their time spent at specific locations, their routes of visiting etc.) and potentially their social grouping patterns (whether they explore the exhibits alone or with peers) for a more comprehensive understanding of learner/visitor learning behaviors.

Table 3. Participant's Time Spent in Each Station and App Ranking.

Application	Quiver		Spacecraft		Wikitude		Just Science	
Participant	Time	Ranking	Time	Ranking	Time	Ranking	Time	Ranking
001	**8.8**	**1**	0.9	2	4.5	4	3.1	3
002	**12.5**	**1**	0.8	3	1.5	2	1.9	4
003	7.3	2	3.1	1	4.3	3	2.1	4
004	**7.1**	**1**	1.2	2	4.3	4	4.3	3
005	**8.4**	**1**	2.2	2	4.6	4	0.1	3
006	4.4	2	1.9	1	2.7	4	2.8	3
007	**11.2**	**1**	0.0	3	.5	2	0.0	4
008	**11.6**	**1**	2.3	2	1.0	3	2.1	4
009	0.2	-	4.3	3	4.3	2	**5.8**	**1**
010	5.9	2	4.7	1	4.3	4	2.4	3
011	7.0	**1**	4.3	2	4.4	3	1.3	4
012	5.0	**1**	2.4	2	2.1	4	2.6	3
013	3.0	2	2.5	4	**6.4**	**1**	4.5	3
014	10.7	**1**	2.4	2	1.1	4	0.8	3
015	1.6	2	2.9	1	3.5	4	2.2	3
016	5.1	**1**	3.4	2	3.5	4	2.9	3

Implications

Informal learning spaces are increasingly serving as hubs for self-directed, collaborative and authentic learning. One of the biggest challenges to evaluating learning in these spaces is to capture learning results in open and flexible contexts. Mobile tablet devices and applications have helped address this problem (Kumar, Tissenbaum & Berland, 2017). However, most mobile learning solutions rely on some extent of voluntary inputs and interactions between users and physical devices. Such a human-to-machine (H2M) communication

paradigm is important, but moving toward a machine-to-machine (M2M) communication paradigm where the environment can automatically react to some events and movements would enhance learners' experiences without interrupting their flow of learning experiences (Alletto et al., 2016; Chin & Chen, 2013).

RTLS is an emerging technology that can address this need. Log and positional data from RTLS present procedural and contextual information about learning/visiting activities. Such data can be processed to serve as indicators of learners' levels of engagement with physical objects and materials, and their social and grouping activities (Ortiz-Vazquez, Liu, Lan, Chae & Natriello, 2017). In this pilot test, we demonstrate one example of such insight for self-directed exploration. There are more areas that need to be further investigated. Future research topics include:

- Space design: How do participants move around variously designed learning spaces (such as interactive exhibitions)? To what extent do those movements reflect educators/facilitators' expectation? How can RTLS data facilitate learning space design?
- Topics of interest: How do learners' movements in an open learning space reflect their interests about various topics? How can this information be used to facilitate personalized learning experiences in an innovative learning space?
- Learner behaviors: How do learners use various areas during learning events? How do learners interact with others and socialize in these events? How might these behavioral patterns (if any) contribute to their learning experiences?
- Resources organization: How are learning resources, various pieces of furniture and tools used in innovative learning spaces? What are the relationships and patterns (if any) between learning activities and learning resource utilization in various learning events?

With a more comprehensive research design and further automation of the data processing and analysis activities, RTLS data can enhance tangible, full-body and ubiquitous learning research and help educators and facilitators create personalized and adaptive learning experiences in innovative learning environments.

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Understanding school furniture issues through visual research in participatory design

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Abstract

This paper uses visual research, as part of a human-centred design project, to illustrate issues that children and teachers have with school furniture in a typical English primary classroom. Understanding the expectations and behaviours surrounding these issues provides valuable information for designers seeking to improve contemporary classroom furniture and for those in education transitioning from traditional to innovative learning environments. Selected studies represent the experiences of a primary class teacher, primary pupils, and the designer/researcher's own observations. Typical school furniture designs (in England) are derived from the 1970s. As classroom furniture is innately connected to teaching practice, and school culture, these out-of-date designs are inappropriate for 21st century teaching and learning. A European standard for school furniture provides information on size and safety testing but there is little else available regarding today's classroom furniture requirements to guide designers and to stimulate much needed change.

Keywords

PRIMARY SCHOOL FURNITURE | HUMAN-CENTRED DESIGN | VISUAL RESEARCH

Introduction

The importance of good seating in a classroom cannot be underestimated. It is an educational tool (Cornell, 2002; Harvey & Kenyon, 2013; Medd, 1984), and the physical connection between a child and his/her learning environment. Harvey and Kenyon (2013, para. 13) define the design thus:

> *"Good seating design enables seamless and transparent change from task to task, but poor design likely evokes irritability, annoyance, or even anger about not being able to accomplish learning or teaching goals, thus interrupting comfort, learning engagement, and collaboration."*

A wealth of ergonomic evidence exists on the mismatch in size between classroom furniture and the children using it (Bond et al., 2002; Brewer, Davis, Dunning & Succop, 2009; Gouvali & Boudolos, 2006; Mandal, 1984; Panagiotopoulou, Christoulas, Papanckolaou, Mandroukas, 2004; Parcells, Stommel & Hubbard, 1999; Saarni, Nygård, Kaukiainen & Rimpela, 2007), and on the impact this has on children's physical wellbeing (Murphy, Buckle, Stubbs, 2007). Despite this, in England, classroom furniture design has changed very little since the middle of the last century. For example, a typical classroom chair used in primary schools today is based on a design first launched as a school chair in the 1970s.

Part 1 of the EU standard for school furniture (BSI, 2015) contains functional dimensions for tables and chairs. Resolving the size issues outlined above may appear to be a process of applying the correct dimensional data to school furniture designs, but this overlooks social and cultural factors in education that also affect

the furniture's use. Therefore, the problem needs to be understood in a broader context where there are other dimensions that come into play; particularly matters of comfort and safety (Cornell, 2002) that cannot be understood with a tape measure.

In Western culture chairs are familiar forms that are "culturally embedded" (Naylor & Ball, 2005, p.60). Like-wise, the elements that constitute a classroom (for example classroom chairs) are so familiar they remain unquestioned (Pointon & Kershner, 2000). This paper seeks to address this situation by putting classroom chairs under a spotlight. Using a design methodology that gains insights from the teachers and children at the forefront of education, it brings to light hitherto unseen issues with the design.

Background to the research

The scenarios presented here are drawn from phases of PhD field research, carried out in one classroom in a Greater London state primary school over three academic years. The overall project aim was to improve the design of school chairs through participatory research. The chairs were already being used in the classroom. The design comprised a moulded polypropylene seat fixed to a metal-leg framework, and complied with the relevant standards for school furniture (BSI, 2012; BSI, 2015).

Methodology

The purpose of the scenarios reported here was to understand the teachers' and children's experiences of using the chairs within a primary school classroom context. A human-centred design (HCD) methodology investigates design matters through stakeholder engagement so that their insights inform design solutions. This could include people in contact with an object during any stage of its lifespan; manufacture, distribution, intended use and final disposal or recycling. It is an iterative process requiring cycles of observation, idea generation, prototyping and testing. Scenarios below relate initial design research and not subsequent product design development.

HCD has similarities to ethnographic methodologies in seeking to understand a person's lived experience - in this instance of a school chair - through research in a real-life setting. Participating stakeholders are considered experts in their own experiences and the researcher's role is to elicit these insights so that they can inform workable design solutions. Theories, and eventual design solutions, emerge from the process placing this research within a constructivist domain; in which designed objects have different meanings for different people (Crotty, 1998). In investigating and interpreting these multiple meanings, the researcher, who is also the designer, accepts that their subjective engagement is part of the data (Flick, 2009). Triangulating data from different sources mitigates personal bias. The first step in a human-centred design process is to understand the real nature of the problem to be resolved (Norman, 2013).

Methods

The methods used, observation and interview, are common in HCD research. Visual data, in photographs or drawings, captured observations and provided a focus for informal interviews. During the course of the study incidental conversations took place between the researcher and participants. These were noted and added contextual richness to the data.

Visual research can reveal "visible" cultural traits in institutions that nevertheless remain "unseen" (Prosser, 2007, p.14) by its inhabitants. In a school context these represent a "hidden curriculum" (Margolis, 2007, p. 11) that, in this case, can affect the way that school chairs are used and so can affect school children.

Images hold different meanings for different people making interpretation of visual data a challenging activity (Margolis, 2007). The images presented here were interpreted in consultation with the class teacher or with a physiotherapist or with reference to the children's transcribed interviews.

Research ethics and child protection

Research was approved by the University of Brighton's School of Arts and Design Research Ethics Committee. Prior to studies commencing participants gave informed consent, or - in the case of children - informed assent. Parents or carers had also consented to the children taking part. Studies were designed with reference to the British Educational Research Association Ethical Research Guidance (BERA, 2011). Personal data arising from the research was managed with reference to the Data Protection Act (1998). To carry out field research in a school with children, the researcher was required to have a Disclosure and Barring Service certificate. To protect participant's identities, pseudonyms were used and photographs were pixelated appropriately in order to obscure individuals' and the school's identity.

Participants

All participation was entirely voluntary. From a total of forty-nine child participants, who took part in a number of different studies, this paper reports on the experiences of only three. Two teachers who worked in the classroom in different academic years were observed and one was interviewed. The researcher became immersed in the classroom as a voluntary helper for a short time prior to each research phase. This presented an opportunity to get to know the children and teachers, and vice versa, and to observe classroom procedures and the children's seated behaviours first hand.

Findings: The problem with chairs

In keeping with the ethnographic nature of the research, findings are presented in a narrative form illustrated by photographs, or drawings. The photographs presented below were taken by the researcher during field research and appear in a doctoral thesis (Lightfoot, 2016).

Photographs of the children sitting, working in the classroom were used to elicit the class teacher's thoughts in a series of informal interviews. An image of a child sitting perched on the front of his school chair (Figure 1) prompted the class teacher to say that this type of behaviour annoyed her, giving the following three reasons:

> *"… the fact that the chair's not tucked into the table… it's a safety hazard for the other children and he's likely to fall off… "*
>
> - (Lightfoot, 2016, p. 122)

Children often perched on their chairs and the researcher also observed problems associated with this behaviour. A child might slip off his/her seat, although this was a rare event. More frequently, a passing child or adult would trip on a protruding chair leg. The legs of chairs cast adrift in the classroom could become entangled, making access and egress a challenge, with children having to clamber in and out of their seats. This also hindered circulation around the classroom, making it hard for the teacher to carry out her work (Figure 2 and 3). To counter these problems, it was expected, though not always enforced, that children should keep their chairs tucked close to the table. However, when the children were working the chairs did not stay tucked in for long.

The notion that chairs should be tucked in was reinforced when a visiting occupational therapist (OT) recommended to the teacher that, children should sit with their chair tucked in, their backs against the backrest

and feet flat on the floor. Sitting this way should provide good biomechanical support. However, the following three scenarios reveal the difficulty children had in maintaining this seated posture and why, despite being expected to sit as described above, they ended up perching.

SCENARIO ONE

Participating children were asked to sit as the OT had described above. Their physical responses were photographed and they were asked to say what it felt like to sit that way. As an example, the smallest participant, Yasmin, immediately pointed out that she could not sit with her back against the backrest and have her feet flat on the floor. She could just touch the floor with her toes when her back was against the backrest (Figure 4). Conversely, when her feet were placed flat on the floor she could not get full support from the backrest (Figure 5). Yasmin demonstrated how she had to sit, perched on the front of the seat, when she worked at a table (Figure 6). She added that she would like to have been able to lean against a backrest occasionally, but couldn't while she was working.



Figure 1. Child Perching. (Source: Lightfoot, 2016, p. 122).

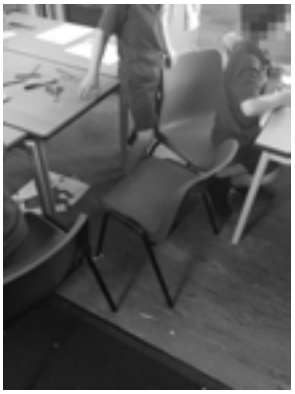

Figure 2. Obstruction. (Source: Lightfoot, 2016, p. 125).



Figure 3. Obstruction. (Source Lightfoot, 2016, p. 125).

The physiotherapist commented that the chair was the wrong size for Yasmin as it was too high and too deep. However, a visual inspection of the chair's form (Figure 4) indicates that the backrest inclines away from the table and the seat inclines from front to back. Both features encourage the sitter to recline, into the form of the chair and away from the table, where the work is. Therefore Yasmin had to strive against the design to be able to see and reach her schoolwork.



Figure 4. Back to backrest. (Source: Lightfoot, 2016, p. 159).



Figure 5. Feet on floor. (Source: Lightfoot, 2016, p. 159).

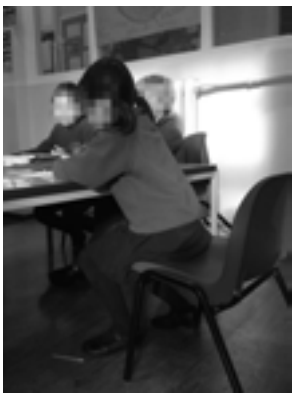

Figure 6. Perching. (Source: Lightfoot, 2016, p. 160).

SCENARIO TWO

Lily was observed perching on her chair (Figure 7) and a corresponding field-note excerpt reads:

> *"Lily showed me (unprompted) that it is the shape at the back of her seat (lumbar support) that presses on her back and is uncomfortable. She tells me that she has to lean forward to stay comfortable."*

The chair design incorporated a curved backrest intended to support the sitter's lower back (lumbar region). Lily's discomfort indicates that the support is either in the wrong place or is the wrong shape for her back. To be comfortable while working, Lily had to perch on the front of her seat.



Figure 7. Lily Perching. (Source: Lightfoot, 2016, p. 124).

SCENARIO THREE

Figures 8 to 10 below, illustrates a regular classroom occurrence. Shared resources, such as coloured pencils, were kept in a container, placed centrally on the tables. Jamie was observed sitting close to a table (Figure 8). When he stood to reach for a pencil, (Figure 9) the action of straightening his legs caused the back of his knees to push the chair away behind him. On sitting again, to use the pencil, he ended up perched on the front of the seat (Figure 10).



Figure 8. Sit. (Source: Lightfoot, 2016, p. 123).



Figure 9. Stand Figure. (Source: Lightfoot, 2016, p. 123).



Figure 10. Perch. (Source: Lightfoot, 2016, p. 123).

Discussion

In relation to chairs within the complex setting of a classroom, matters of comfort and safety appear opposed. The children's behaviour - perching - is caused by the adoption of comfortable working postures but this causes chairs to become safety hazards. On seeing a safety hazard the teacher may then ask children to sit in a way that they find difficult to maintain in comfort. To complicate matters this is reinforced by an OT's advice on sitting.

A critical evaluation of this type of school chair design, based on findings presented above (Figures 4 – 6), show that it does not offer good support for primary school children sitting and working at tables. The seat incline and backrest angle are counterintuitive and instead of helping children get close enough to see and to reach their work comfortably they are encouraged, by design, to assume an opposing posture. Children adapt themselves to compensate for design deficiencies. Perching happens unconsciously and it would be unreasonable to expect children to sit uncomfortably or to have difficulty seeing and reaching their work.

Unless asked specifically, the children above were all focussed on their schoolwork, unaware of how they were sitting. During the course of the research children were often observed perched on their chairs whilst engrossed in their work. It is notable therefore, that the teacher was not annoyed by a lack of attention to schoolwork but by the effect the children's seated behaviour had on the chairs and the associated implications for children's safety and her ability to move around the classroom.

Conclusion

These insights, gained from applying a visual research methodology, reveal that the chair design causes problems for the teacher and the children, but for different reasons. In uncovering hitherto unseen impacts of school chair use the findings demonstrate that visual research is a valuable tool for investigating the multiple meanings of designed objects in a classroom environment.

The process provides vital information for those in the school furniture industry to consider when designing and specifying new products for contemporary classrooms. Furthermore, it provides valuable information for teachers to understand how classroom behaviours can be influenced by design. This knowledge is useful in advancing teaching practices and in transitioning from traditional to innovative learning environments.

Limitations and scope for further research

The location in a single classroom limits the research. The experiences of a relatively small sample of teachers and children are represented. Many classroom elements may be similar but others, such as available space, school ethos and pedagogical approaches, may vary considerably. This could be problematic if there was only likely to be one solution to the problem. However, the research does offer a methodological approach for interrogating classroom furniture design and as such is one step towards improving teaching and learning environments.

There is more work to be done. Further research could include developing the design of new seating in response to these findings or, a similar study focussed on different types of furniture, such as classroom tables. To stimulate change, school furniture design guidelines are required. These would set out the furniture needs of contemporary teaching and learning and complement the available data on safety testing and size. To avoid replicating the type of issues described above guidelines should be generated through collaborative education and design research.

Acknowledgements: Research was funded by the Arts and Humanities Research Council, and supported by the University of Brighton. Gratitude is extended to the school at the heart of the research, as it could not have happened without the school community's willing support.

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The students redesign their school (with teachers): Heart, mind, hand

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Abstract

Through a collaborative design approach, Don Milani Institute of Higher Education attempted to re-design their own school by replacing the spatial rigidity with Readable Subject Classrooms that were assigned to teachers, having a more flexible setting and creating a campus through the connection of three existing school buildings. The action-research methodology has been used to lead this project. All teachers, students, parents and workers were provided a questionnaire to identify the problems. All teachers attended two training meetings. Afterwards, a group of teachers attended four training workshops and, with a group of students, attended three collaborative design workshops and focus groups, gathering desires and needs. The project curators proposed a renovation and reorganisation plan leveraging the stakeholders' suggestions. The first phase was developed between May 2017 and April 2018 to be completed before the construction phase scheduled for summer 2018. The collaborative design would help teachers and students to work better together and increase their identification with the school.

Keywords

PEDAGOGY AND ARCHITECTURE | OLD SCHOOL REORGANISATION | COLLABORATIVE DESIGN | FLEXIBLE LEARNING | ENVIRONMENTS | READABLE SUBJECT CLASSROOMS

Introduction

The need for innovation requires a shared methodological and pedagogical perspective among the teachers, the creation of a common language and a strong educational community that will accompany the students through their education system. In order to create an interconnected and interactive relationship between people, spaces and objects, there is the need for serious consideration about pedagogy (Limone, 2012), the way to act in the classroom and the educational environment.

Those are the two main aspects that form the basis for implementing a radical pedagogical didactic innovation at Don Milani Institute of Higher Education by introducing Readable Subject Classrooms (Kaplan, 1987; Lynch, 1960), assigned to teachers with the aim of developing active student-centered learning areas and to propose innovative ways such as cognitive flexibility (Spiro & Jehng, 1990), EAS (Situated Learning Episodes) (Rivoltella, 2013) or other possible didactic and methodological approaches.

The learning environments have some basic epistemological principles: learning is developed through a conscious and active path, in which the student is at the centre of this process and the teacher is called to play the role of facilitator (Perkins, 1991), because learning is no longer transmissive, but intentional and reflective (Jonassen & Land, 2012; Lippman, 2010). A further aspect that made it necessary to rethink the school organisation, concerns the lack of classrooms and the reduced size of some of them. This required an architectural design with spaces being demolished and reconstructed.

Context

The Don Milani Institute of Higher Education in Montichiari (Brescia-Italy) is attended by about 1,700 students and 200 teachers. The areas of study are: Science; Language; Sport Science, Cinema, Environment, Human Sciences; Technical Administration, Finance and Marketing (day and evening) and Business Information Systems; Professional Commercial Services and Technical Assistance. Don Milani consists of three buildings (another one will be built soon). Two are contiguous and are built in a common garden. One of them is very recent, while the other is an historical building and the first to have been built. The last building, occupied by the professional institutes, is separated from the other two by a road, and is a rather degraded prefabricated structure. Don Milani was built according to the traditional "box-like" logic "containing many smaller boxes lined up in various rows, in a series of superimposed levels" (Bruner, 1961, p. 157), with classrooms not suitable to the needs of new teaching methods.

One of the priorities for which the reorganisation of the school is important to overcoming the physical and psychological separation between the three buildings in order to create a campus and a community, as well as making it more beautiful and innovative. To do this, it is necessary, in addition to an overall reorganisation of spaces and equipment with a specific pedagogical model, to have economic resources which are not always present. For this reason, the headteacher has involved many local institutions in a fundraising campaign: Municipality of Montichiari in?The Province of Brescia, all of its citizens and Credito Cooperativo del Garda Bank which has issued "BCCinclasse" Solidarity Deposit Certificates.



Figure 1. The atrium before and after reorganisation. (Source: Authors).

Research design

A rethinking of the classroom settings and a reflection on all the common areas, halls, corridors, outdoor spaces and environments that could be readapted for alternative ways of "doing lessons", has become necessary to overcome the current rigidly consolidated setup. The task of the school is to help each student in a process where everyone shapes himself in order to become a person (Maritain, 1943). That is to say every student must be recognized by the teachers in his or her originality, unrepeatability and uniqueness (Bertagna, 2006). This is for the integral growth of the student (Bertagna, 2006) and that the basic right to schooling and education is recognized for everyone (Mounier, 1935). An educational community needs to have professional tools that allow translation of their established values into teaching practices. The practices are supported by environments that have an educational intention to develop relational aspects, "we learn together, not alone" (Górkiewicz, 2016, p. 7).



Figure 2. The corridors before and after reorganisation. 2018. (Source: Authors).

To do this, it is necessary to develop a shared path, not only between teachers and students, but also between parents and all the school staff, in which they are all participants and protagonists through the design and improvement of space and all the activities to be carried out (Parnell, 2015).

The principal prepared the teachers for the change through the communication of the new didactic-methodological needs, the creation of "a sense of urgency" (Kotter, 1996, p. 35), the need to have the necessary knowledge, skills and competencies to cope with the change collectively (Armenakis, Harris & Mossholder, 1993) and with a shared project (McKay, Kuntz & Naswall, 2013), through a training course on Didactics for Skills (Sandrone, 2013) and on EAS (Rivoltella, 2016).

However, the organisational and methodological change requires great effort and places strain on the part of teachers, who are often immersed in the tradition of "single cells" (Osborne, 2016, p. 37). It is a very difficult transition because teachers do not always manage to break away from well-established consolidated practices. The transition to modern learning environments represents an adaptive and transformative change that requires "establishing agreement on the purposes of schooling and the proposed changes, along with a truly shared vision of possibilities" (Waters, Marzano & McNulty, 2003, p. 8). The transition is also a break from the past that sometimes clashes with the prevailing values and requires new knowledge and skills for the use of technological tools and new methodologies (Heifetz & Laurie, 1977; Waters, Marzano & McNulty, 2003).

A further complication for change is the sense of threat that teachers can feel because the skills and competencies they use may not be as appropriate (Heifetz, Grashow & Linsky, 2009). For this reason, the "transition" from frontal and transmissive didactics to a new didactics methodology should be shared by all the protagonists (Imms, 2016). In communities, the connection between people for a common purpose is not based on contracts, but on everyone's commitment (Sergiovanni, 1994) and is bounded by interdependencies for the construction of an idea (Blau & Scott, 1962). Creating a community means building a 'centre of value' in which the meaning of "us" is realised (Sergiovanni, 1994).

These changes can lead to improvement in learning (Barret, Zhang, Davies & Barrett, 2015) and also a greater involvement of students in a more empathetic school where there is widespread physical and mental well-being (Washburne, 1957). It is important, however, to work with teachers to develop an awareness of the influence that learning environments have on making better and more reflective use of space (Dudek, 2000).

For this reason, a collaborative planning path was chosen to encourage teachers, students, parents and all the school staff to develop a sense of belonging (Woolner, 2015), through "heart, mind and hand" in a vision that recalls the pedagogy of Pestalozzi (1946). In the collaborative design activity each one has their own role in

"the place where everyone works" (Sandrone, 2008, p. 189) and this allows balance to be found, unity and spirit of family intimacy (heart), putting in the field reflection, imagination, creativity (mind) to be carried out in laboratory activities (hand).

Methodology

This project adopts the action-research methodology guide. The first phase lasted approximately one year, from May 2017 until April 2018. The first phase ended with an event in which the innovation project was presented to all the representatives of the school, the mayor of Montichiari and the mayors of other neighbouring municipalities, local institutions, and journalists and representatives of the Credito Cooperativo del Garda Bank. From May 2018 the actual operational phase started (which is still under way) and involves a space reorganisation, a new pedagogical approach and an architectural restructuring intervention.

The course has developed in three directions: teacher training, collaborative design for teachers and students and involvement of parents and school staff through questionnaires. The training of teachers involved two applications: the EAS with meetings held by Professor Rivoltella that took place throughout the school year and the Didactics for Skills with theoretical and workshop meetings held by Professor Sandrone with the following articulation:

- **First part theoretical**: 2 meetings of 3 hours each dedicated to all teachers during which the normative and pedagogical reasons for which Italian (and European) schools have to review their educational action was discussed and set up paths aimed at promoting the development of skills through the disciplinary knowledge of each course of study;
- **Second part workshop**: 4 meetings of 3 hours each addressed to a group of 25-30 interested teachers, during which they used the teaching methods that can promote the development of skills and optimise a spatial organisation based on the classrooms.

The collaborative design was carried out through 3 workshops of 4 hours each: one with the teachers, one with the students and one with both teachers and students working together.

The workshops with teachers and students were structured as six stages in different settings:

- **Setting: frontal**. Greetings and introduction to the workshop with a short presentation of the activities;
- **Setting: circle time**. Who are you, where do you come from and what is your idea of school? Each teacher/student was invited to fill in the form expressing their idea of school, then do a group presentation;
- **Setting: in pairs**. What is a classroom made of? 1) diamond ranking: each pair of teachers/students must have nine images, which refer to the classroom space, in order of importance: 2) pin-up: each pair pins up the completed template and argues their own choices;
- **Setting: individual**. How is my classroom? 1) physical model construction: each teacher/student must build a model of his own ideal classroom; 2) presentation: each teacher/student relates his or her project;
- **Setting: Group work**. Is teaching possible outside the classroom? Each group must include teachers/students of all the locations. 1) Identification of common areas 2) Identification of areas useful for the development of didactic or informal activities; 3) Identification of the functions that these spaces can have;
- **Setting: Debate and circle time**. Considerations on the work: questions, perplexities, suggestions and reflections. Conclusions and greetings.

The workshop with students and teachers working together was centred around the use of corridors or other spaces. It ended up with a focus group which highlighted aspects which required great focus:

- the areas to be added to the campus, and
- the critical issues presented by the separation between the buildings.

The focus group also highlighted operative suggestions that were put forward to be taken into account during the design phase involving the local administration. Parallel to the design process, questionnaires were given: (1) two questionnaires to teachers, one in May 2017 before the Teachers' Board, where they decided to undertake a course of didactic and methodological change and one in November before another Teachers' Board during which the design path was presented; (2) one to students, parents and all the staff of the school. The results and the images of learning environments before and after the reorganisation and renovations were presented in the meeting with all teachers and school representatives (parents, students, school staff) in November 2017 and also at a public event in April 2018.

Final considerations

In the questionnaires, some considerations emerged in relation to the vision that each stakeholder had of the school and their expectations. Basically, depending on the building in which they were located, they saw the school as a prison (professional building), hospital (historic building) or aggregation centre (new building). Most of the students, teachers, parents and school staff would like the school as a centre of aggregation or as their home (Volpicelli, 1964): an empathetic place (Mallgrave, 2015), familiar, beautiful, bright, quiet, open, welcoming and a place that encourages positive well-being.

Regarding the introduction of the Readable Subject Classrooms, teachers were very supportive of this innovation because they were convinced that these classrooms allow great flexibility and the possibility to use different teaching methodologies in order to meet the different ways of learning of each student. Moreover, 'owning' a classroom, although shared with a colleague, allows all material to be readily available and allows greater collaboration with colleagues of the same discipline.



Figure 3. Historical building classrooms before and after reorganisation. 2018. (Source: Authors).

The opinion of the students varied, however, depending on the building they attended: students in the historical and professional buildings were generally more favourable than those in the new building. About half of the parents did not fully understand the importance of the classrooms, even if they did consider the possibility of having flexible spaces with innovative methodologies to be important.

The majority of teachers and students believe that changing the classroom was positive. It allows a "decompression" pause in order to increase the threshold of attention; open the mind to change because the organisation of space reflects the organisation of the mind (open-closed); facilitates concentration with greater emotional involvement; overcomes the idea of disciplines as closed spaces; overcomes the separation between theory and practice; and finally, there is less mind saturation and less boredom. Students saw the possibility of socialising with students of other classes and to take possession of all the spaces of the school.



Figure 4. Professional building classrooms before and after reorganisation. 2018. (Source: Authors).

The majority of the responses of the school staff were appreciative because they thought there would be fewer problems with the arrangement of classrooms since the teachers managed the spaces. The parents were less convinced because they thought time was wasted in the transfer from one classroom to another.

In the focus group, teachers and students recognised the leadership skills of the principal who was able to motivate and create the right conditions to accompany teachers, students and school staff towards a difficult and demanding transition. This was achieved with the approval of the majority of parents.

The students expressed their pleasant surprise in discovering that the design work carried out with the teachers allowed them to feel closer to the teachers and to overcome the distance that they often perceived due to the rigidity of the classroom situation. The collaborative planning path allows stakeholders, as Hertzberger (2008) suggests, to appropriate spaces, changing their role as "users" to "inhabitants".

The idea of a school, that has emerged from all the questionnaires and the observations captured in the various meetings, can be summarised as follows: a familiar and welcoming environment where: (1) students, teachers and all the staff feel at ease to carry out their work in serenity and in respect of others; (2) students can find teachers ready to listen and who transmit their passion for discovery and the pleasure of learning with a fruitful collaboration; and (3) where there is a shared goal both between colleagues and between teachers and students; which enable the exchange of experiences, ideas and different visions of the world.

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Campfire, watering hole, cave, life - David Thornburg interpreted in Ireland.

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Abstract

This study seeks to measure changes in student engagement when a whole school approach is taken to changing the learning environment. Technology is used extensively in teaching and learning. Classrooms have become more porous, students have taken greater ownership of their learning. Initial findings have encouraged us to begin a 'tinkering' module to reflect real life. First and second and Transition Year students take part in a morning of 'tinkering' on their own project work every Monday this academic year. Timetabling has become more fluid and students are being given choices as to which classes they attend. Students can attend some classes with students in different year groups. Teachers have to step back from traditional planning of classes. Differentiation is encouraged. Assessment is different.

Keywords

TINKERING | PERSONALISATION, | CHOICE | TECHNOLOGY | POROUS | DIFFERENTIATION

Introduction

Le Chéile Secondary School is a new Catholic school in Tyrrelstown, Dublin 15. The school was established in September 2014. The school is inclusive of students from all cultures and backgrounds and celebrates diversity. The school aims to ensure that Le Chéile is a place where students feel at ease and cared for enabling them to relate to one another and to staff in an open, respectful and trusting manner. The school values the role of parents in the education of their children and seeks to work in partnership with them.
The school is a one-to-one device school with the use of technology to support teaching and learning well embedded in our practice. Le Chéile is the school with no books' – teachers, and indeed students create their own content, striving to ensure that the needs and learning styles of all our students are catered for. This is the story of how we have used the ideas of David Thornburg, building pedagogy on the concept of campfire, watering hole, cave and life (Thornburg, 2013).

VISION

As a greenfield school opening at a time of significant change in the Irish Education System we recognised the importance of creating a 21st century school both in terms of the culture, curriculum and curriculum delivery.

CATHOLIC CULTURE

Our school culture is derived from the teachings of the Catholic Church regarding education, but it is interpreted for a secular age. It is based on seven root beliefs that all members of our school community live out of every day. These root beliefs are fundamental to the development of an innovative learning environment. We believe that:

- Small things matter
- We are all teachers, we are all learners, always.
- We can transform the world with our creativity.
- The Spirit fills us with joy.
- Seasímid Le Chéile (we stand together)
- We are called to be our best self.
- Differences are to be celebrated.

DEPARTMENT OF EDUCATION AND SKILLS DOCUMENTS

Our vision is also shaped by Department of Education and Skills policy and documents that were published during our initial growth phase, which are briefly described below.

The Framework for Junior Cycle

The Framework for Junior Cycle was introduced in 2015 (National Council for Curriculum and Assessment, 2015). The Framework contains 24 statements of learning, underpinned by eight principles, providing the basis for schools to plan for, design and evaluate their junior cycle programmes. That process of planning focuses on the combination of curriculum components and other learning experiences. Eight principles underpin the Framework for Junior Cycle. These principles are Learning to learn, Choice and flexibility, Quality, Creativity and innovation, Engagement and participation, Continuity and development, Inclusive education and Wellbeing

Looking at our School 2016: A Quality Framework for Schools

In 2016 the Irish inspectorate of the Department of Education and Skills developed and published a new Quality Framework for Schools called 'Looking at Our School'. (Department of Education and Skills, 2016). This framework provides a unified and coherent set of standards for both teaching and learning, and leadership and management in schools. The leading teaching and learning standards call on schools to promote a culture of improvement, collaboration, innovation and creativity. It also calls on school leadership to 'foster a commitment to inclusion, equality of opportunity and holistic development of each student.

Digital Strategy for Schools 2015-2020

A new "Digital Strategy for Schools 2015-2020, Enhancing Teaching, Learning and Assessment" was published in October 2015 (Department of Education and Skills, 2015). This strategy is the adaptation of the UNESCO ICT Competency Framework for the Irish context, drawing also from other relevant European and international Digital Competency Frameworks.

The Digital strategy promotes students being exposed to new forms of learning and collaboration that support their different styles of learning. The digital strategy also promotes teachers taking a more facilitative role, providing student-centred guidance and feedback, and engaging more frequently in exploratory and team-building activities with students.

Schools are asked to be fully engaged in using ICT to "support an enquiry process and enable their students to work on solving complex real- world problems" by engaging in "collaborative project-based learning activities that go beyond the classroom" (Butler, Leahy, Shiel Cosgrove J, 2013, p. 8).

THORNBURG'S CAMPFIRE, WATERING HOLE, CAVE, LIFE

David Thornburg identifies four archetypal learning spaces— the campfire, cave, watering hole, and life—that schools can use as physical spaces and virtual spaces for learning.

The campfire is a space where people gather to learn from an expert. In today's schools, the experts are not only teachers and guest speakers (both in person and online), but also students who are empowered to share their learning with peers and other teachers. The cave is a private space where an individual can think, reflect, and transform learning from external knowledge to internal belief. Thornburg (2013) suggests schools should develop practices and places that encourage and facilitate this private individual time. The watering hole is an informal space where peers can share information and discoveries, acting as both learner and teacher simultaneously. This shared space can serve as an incubator for ideas and can promote a sense of shared culture. Finally, **life** is about taking knowledge into the world for use and application.

Methodology

This research is carried out by means of a case study. Case study research refers to an in-depth, detailed study of an individual or a small group of individuals in this case the development of an ILE in one Irish school, based on the work of David Thornburg. This study is qualitative in nature, resulting in a narrative description of experience in the school. The main characteristics of case study research are that it is narrowly focused, provides a high level of detail, and is able to combine both objective and subjective data to achieve an in-depth understanding.

The researcher undertook a variety of approaches and methods to collect data. These methods included questionnaires, direct participant observations and a review of documents. The data is interpreted holistically. A holistic approach reviews all of the data as a whole and attempts to draw conclusions based on the data in its entirety.

Interpretation and Commentary

Initially our school vision was simply to offer as broad a curriculum as possible. This we believed would enable students to work to their strengths, provide for student choice and encourage engagement and fuller participation in line with the principles underlying Junior Cycle reform. We realised that students needed a variety of teaching methodologies that moved away from the traditional bias for the verbal learner. To this end we decided to go the route of one to one tablet devices for all students. We also opted for the virtual learning platform, schoology.

Two other innovations in our curriculum over the past two years have also encouraged us to move further into the innovative learning environment space. During the Transition Year we developed a 'it's your call' model for the teaching of Irish, English and Maths. Students choose the night before class which subject they will attend the next day. Teachers have to develop units of learning that students can work on independently.

We offer a Blue Sky module to first, second and Transition students. Our Blue Sky module is influenced by Brightworks pedagogy that has arcs of exploration, expression and exposition. Blue Sky offers twenty different workshop style classes in topics as varied as bicycle maintenance, skincare, geo-maths and economics. Students self-selected which courses they wanted to participate in and develop their own project during the one-hour Monday morning class. Students now take ownership of their learning – including the ability to be self-directed, a decision-maker, and a manager of priorities in and out of school. Blue Sky groups are made up of students of different ages and experience.

CAMPFIRES

Root Beliefs: We are all teachers, we are all learners, always.
Key Skills: Managing Information and Thinking, Communicating

The implementation of flipped learning as a methodology has been hugely beneficial for the students as it has enabled a truly personalised and differentiated approach to their learning. Flipped learning is used to relocate direct instruction of new concepts to homework time and allocate lesson time to active learning activities. Teachers use Explain Everything to create instructional video resources to implement a flipped learning approach.

Resources are created that align with the curriculum and that are appropriate for the students' abilities and learning styles. Through the flipped approach there is opportunity to stretch and challenge students as well as create resources that are more heavily scaffolded and guide student learning. There is no doubt that this approach has led to students "experiencing joy, satisfaction, passion and success in their education and lifelong learning" (Department of Education and Skills, 2015, p. 13).

Thornburg (2013) suggests that the 'expert' at the campfire often gives too much information. In order to promote students' ability to 'learn how to learn' a group of four teachers is leading a project in the school to develop higher order questioning skills among the teaching staff and students. As we learn to use the campfire space more appropriately within the classroom, teachers are encouraged not to give away too much information and to set students free to find the material they need themselves.

The data projector and whiteboards afford 'the expert' the tools for sharing campfire information. Other spaces in the school that are used for this type of instruction are stairways, tiered seating in the learning plaza and the theatre style room in the school.

WATERING HOLES

Root Beliefs: Differences are to be celebrated. Seasaimid le cheile (we stand together).
Key Skills: Communicating, Working with others

Watering holes are based on the social constructivism theory of knowledge (Thornberg, 2013). They emphasise the collaborative nature of much learning. When we are with others and have the opportunity for discussion we produce knowledge that is different from when we work alone. Our classroom furniture is organised to facilitate group work. Our chairs have five different colours to easily allow the formulation of larger groups. The classroom windows are used as dry wipe surfaces for brainstorming. Our corridors have seating areas and occasional groupings of comfortable chairs to encourage students to stop and chat. Our online platform Schoology facilitates ongoing conversation and the sharing of work even when students are not in school or if they are in different classes or year groups.

We particularly focus on active and collaborative learning, enabling students to use and analyse information in new and creative ways, to investigate issues, to explore, to think for themselves, to be creative in solving

problems and to apply their learning to new challenges and situations. We try to incorporate the learning space into our lessons so that the ideas, attitudes and values being taught are reflected in our physical environment, for example a class teaching an element of a court case might be organised as a courtroom, chairs may be laid out in the formation of the Orchestra when this is being taught etc.

When students are working together they have the freedom to leave their classroom and use all the space inside and outside the school. We focus on trusting the students that when they are working in this context they remain focused on the topic.

CAVES

Root beliefs: Called to be my best self. Small things matter.
Key Skills: Managing myself, Staying Well, Managing information and thinking.

Thornburg (2013) reminds us that all learning does not require activity that can be observed by others. In a world where 'active' learning is encouraged, the cognitive constructivism of Piaget can often lose out to the Social constructivism of Vygotsky (Lourenço, 2012)

Students internalise what they know through experimenting and reflecting on observations. Self-directed meaning making is a critical skill for life and the cave learning space archetype has reminded us to build this space into our curriculum, our pedagogy and our building. This is reflected in the personalised learning of the Transition Year module but also now built into many lessons that allow students time to think and reflect at their own pace. This contributes to the wellbeing of students and also is more inclusive, taking into account the introverted and extroverted nature of different students. At Le Chéile Secondary School we are focused on an education that enables students to make sense of their experience. The cave space facilitates students to learn in this way by providing space within the busy school day to assimilate beliefs, values, feelings and judgments of others and thereby come to make new meanings out of life situations (Mezirow, Taylor & Associates, 2009).

Teachers are encouraged to create 'caves' in their classrooms even if it is only a table and chair facing a blank wall where students can go to reflect on learning alone. One teacher has gone so far as to create an actual cave from old books where students can quietly read or just be. Other cave spaces around the school are provided in the library with individual study booths and in the prayer room. We also provide some 'cave' spaces within the staffroom in the form of enclosed stand-alone booths. It is a work in progress to let go of the anxiety that if a student is not following the rest of the class that he is not engaging. We are still learning to trust each other's caves!

LIFE

Root beliefs: We can transform the world with our creativity. The Spirit fills us with Joy.
Key skills: managing information and thinking, Being Creative.

In 2018 we introduced a 'Blue Sky' module for students in first, second and Transition Year. This module is inspired by the 'life' element of Thornburg's (2013) work. We are anxious that students are able to transfer the skills used in other areas of the curriculum to real life situations. Teachers take a more facilitative role, providing student-centred guidance and feedback, and engage more frequently in exploratory and team-building activities with students. ICT has been invaluable in supporting this "enquiry process and enable their students to work on solving complex real-world problems" by engaging in "collaborative project-based learning activities that go beyond the classroom" (Butler, Leahy, Shiel Cosgrove J, 2013, p. 5).

Learner outcomes in Looking at our Schools suggest that students should enjoy their learning, are motivated to learn and expect to achieve as learners. Students in Blue Sky demonstrate knowledge, skills and understanding

required by the post-primary curriculum but also push their knowledge outside of the curriculum into the real world. Teachers contribute to building whole-staff capacity by sharing their expertise. In many cases the modules that teachers offer to lead are different from their recognised area of expertise. This has created a very positive working environment in the school. In these modules, teachers also work together to devise learning opportunities for students across and beyond the curriculum.

Conclusion

There is a strong correlation between CAT score and student outcomes at Junior Certificate. Analysis of the state exam results against the CAT scores on intake indicate that our students are achieving above their expected level of performance. Feedback from students suggests that the ILE has been a contributory factor. Feedback from parent and student surveys indicate a strong affirmation and recognition of the benefits of the ILE in progressing the school vision and in creating a positive learning experience.

The feedback from both students and parents indicates that the ILE is being used to diversify the teaching and learning methodologies, enable students to be creators of their own learning, support skills development and allow greater interaction between teachers and students. Almost 60% of students surveyed indicate that they are learning in an innovative way and 65% of students indicate that they ask more questions and engage more readily with their teacher. Over 80% of students strongly agree or agree that the ILE has resulted in a greater interest in school and their learning. 80% of parents surveyed strongly agree or agree that since coming to the school their child's performance in school has improved. 59% of the parents felt that their child was learning in an innovative way and recognised that many of the learning experiences would not be possible without the use of the technology. Parents of children with Special Educational Needs were particularly affirming of the impact that the ILE has on their child's progress and ability to access the curriculum.

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Change leadership and the transition to innovative learning environments

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Abstract

While considerable effort goes into getting the design elements right in an innovative learning environment (ILE), ultimately its success hinges on the teaching staff's ability to use the new spaces to full potential. Despite this, what school leaders can do to support teachers to transition their practice when moving into an ILE remains under-researched. This paper will explore a theoretical framework comprising three essential stages when leading staff through the process of transitioning into an ILE: (1) preparing for change; (2) implementing change; and (3) sustaining change. Without a clear understanding of how to lead change in teacher practice, many ILE implementations may be unsuccessful.

Keywords

CHANGE LEADERSHIP | INNOVATIVE LEARNING ENVIRONMENTS | TEACHER CHANGE | TRANSITION

Introduction

One of the primary challenges associated with implementing innovative learning environments (ILE) is the need to support teaching staff to transition from some of the values, beliefs, principles and practices they may have held and employed for a very long time. For instance, moving into an ILE may mean teachers need to move from believing that one teacher can best meet the needs of a group of students to believing that working as a team is the best approach; moving from enjoying high levels of autonomy when planning lesson to embracing a need to compromise and accommodate the wishes of all team members. This transition may also require considerable professional learning in areas such as collaboration, pedagogy and space, and flexible environments. These kinds of change, requiring not only shifts in individual mindsets, but also shifts in the culture of the organisation attempting to implement them, sit at the most challenging end of the change spectrum (Lawson & Price, 2003).

> *Snapshot: "I'm an old dog- I've been around for a while. We went through all this back in the seventies. How is it going to be any different this time?". This question, right at the start of our meticulously planned design review session gave voice to what (apparently) a lot of the staff were thinking but not saying. The nodding heads, the murmured comments around the room made it clear that many staff didn't see a need for a new building design, let alone a need for them to be part of the design process. It also made it clear just how challenging the road ahead would be.*

Waters, Marzano, and McNulty (2003) categorise change in relation to the significance or 'magnitude' of that change on the people experiencing it. First order change is that which has a definable problem/solution configuration, "can be implemented with existing knowledge and resources, and where agreement exists on what changes are needed and on how the changes should be implemented" (p. 5).

When experiencing second order change, people often feel that the change is making the situation worse rather than better. There are multiple 'wicked problems' occurring at once, they need to learn new approaches, and the change may conflict with prevailing values and norms. Second-order change is often much more difficult for people to implement and sustain because it disrupts "cooperation, a sense of wellbeing, and cohesion. It may also confront group identities, change working relationships, challenge expertise and competencies, and throw people into stages of "conscious incompetence" (Waters et al., 2003). The implementation of an ILE for many teachers represents second-order change.

Precisely how a school leader should support staff going through this kind of significant change is under-researched. Blackmore et al. (2001) remind us the research literature surrounding innovative learning environments is mostly concentrated in the design phase, with little attention paid to (among other things) "the organisational cultures and leadership that facilitate or impede innovative pedagogies in new spaces" (Blackmore, Bateman, Loughlin, O'Mara, & Aranda, 2011, p. v).

Methodology

As a consultant working in the field of change leadership and transitions into innovative learning environments, my work provides me with the unique opportunity to record and analyse the experiences of a community going through second-order change whilst also being a member of that community. Using analytic autoethnography I am analysing my own experiences (and those of co-participants) against a theoretical framework comprising principles of effective, sustainable change. I am drawing from internal data sources such as field notes, recollections, and memories ('snapshots'), as well as triangulating external data sources including interactive interviews with co-participants and a 'key informant', or trusted advisor who is a respected expert in the field.

Analytic autoethnography is an approach designed to avoid falling into the traps about which Allen warns budding autoethnographers: excessive focus on the self, and a lack of analysis and interpretation: "[You're] telling [your] story – and that's nice – but people do that on Oprah every day. Why is your story more valid than anyone else's? What makes your story more valid is that you are a researcher" (Allen, 2006, cited in Ellis, Adams & Bochner, 2011, p. 276).

ANALYTIC FRAMEWORK

Change is often a complex, non-linear, dynamic process that is difficult to sustain over the long term, with some researchers maintaining that around 60-70% of significant change efforts fail (Cartwright & Schoenberg, 2006; Washington & Hacker, 2005). So, what separates the successful from the unsuccessful? What are the feature of successful change initiatives? They often have a similar set of features:

- They are closely aligned to the values of the organisation. These 'high cultural-fit' changes often use employees' values and commitment to the organisation to drive behaviour (Canato, Ravasi, & Phillips, 2013).
- They are participatory. Employee participation or involvement in decision making related to change is positively related to openness or commitment to change and negatively related to cynicism about, or resistance to organizational change (Choi, 2011, p. 492).
- They are incremental. "Large-scale change happens only in steps" (Lawson & Price, 2003, p. 34). When practitioners have the chance to explore, in relative safety, over time, new ways of operating, their confidence increases, while their uncertainty about, and unfamiliarity with, new approaches decreases (Pfeffer & Sutton, 2013).

In addition to having these features, successful change initiatives also support people through three key phases in the lifespan of a change.

PHASE ONE: PREPARING FOR CHANGE

The notion of *change readiness* centres on ensuring people see a particular change initiative as being "...[an] idea whose time has come" (Aimard, 1861, p. 57), and are therefore more willing to embrace that change. Readiness for change is high when people believe that change is needed; that it is a good fit for both the organisation and the challenge at hand; is beneficial to both the individual and the group; and is able to be successfully implemented (Choi, 2011).

Readiness is also closely linked to the level of adaptive capacity within an organisation, or its ability to cope with disruptive, ongoing change. Organisations that are able to "engage in problem-defining and problem-solving work in the midst of adaptive pressures and the resulting disequilibrium" are said to have high adaptive capacity and are more likely to be able to sustain a change over time (Heifetz, Grashow, & Linsky, 2009, p. 12).

> *Snapshot: My work with one sceptical teacher took a big leap forward when over a holiday break he worked with a nationally recognised expert in indigenous education, an area this teacher was passionate about. The realisation that made the difference for him was that the flexibility inherent in an ILE might offer him more opportunity to meet the needs of his students rather than less. He came to see an alignment with his values and believed that the move to an ILE was appropriate for the challenge he was facing. Having made this connection for himself his readiness for change was increased and he was therefore more open to explore possibilities.*

Developing a sense of urgency around change is also seen as a crucial early step when undertaking any kind of significant transition (Kotter, 1996; Lawson & Price, 2003). As Kotter (1996) puts it: "by far the biggest mistake people make when trying to change organizations is to plunge ahead without establishing a high enough sense of urgency in fellow managers and employees" (p. 4). With a high degree of urgency within an organisation people are more likely to commit to change.

This sense of urgency for change is useful in overcoming status quo bias. Bias towards the status quo can often be attributed to two factors: the uncertainty represented by a new way of doing things (compared to the asymmetrical certainty of remaining with current practice, or 'the devil you know'); and the cost of the change (both in terms of the cost to transition to the new way of operating and the sunk costs (time, effort and resource) already invested in the current way of operating (Samuelson & Zeckhauser, 1988, p. 33).

School leaders can counter the pull of the status quo by doing two things:

1. Removing as much of the uncertainty associated with change as possible. By basing the change on evidence-based, well-researched approaches rather than asking people to change behaviour in the hope that some kind of benefit might be gained.
2. Providing visible proof of benefits by encouraging smart risk-taking and establishing and supporting small prototypes, each of which has less to lose than a few larger ones. As Pascale & Sternin (2005) observe, "seeing is believing". Small, safe prototypes provide 'social proof' to observers, but also minimise what people stand to lose. The greater the potential for loss; the greater pull of the status quo: "what people resist is not change per se, but loss" (Heifetz et al., 2009, p. 10).

PHASE TWO: IMPLEMENTING CHANGE

Leaders can support teachers to implement change by providing them with simple, easy-to-undertake 'first steps'. A low-risk first step helps to overcome the 'knowing-doing gap', or the situation where participants know what they *should* be doing but nevertheless persist with what they've always done. (Pfeffer & Sutton, 2013). A key

to overcoming the knowing-doing gap is that people should make some kind of start, no matter how modest. Pfeffer & Sutton (1999) argue that "action counts more than elegant plans and concepts", and that "knowing comes from doing and teaching others how" (p. 251).

As people begin to operate in a new environment, they will often engage in 'sense-making' or the process of "structuring the unknown" (Waterman, 1990 cited in Weick, 1995). Weick asserts that when people engage in sense-making they (consciously or unconsciously) ask 'what's the story here?' and 'now what should I do?' Left to themselves when structuring the unknown, Kotter (1995) warns people can sometimes create very inaccurate links. To avoid this, school leaders can engage in what is known as 'sense-giving' or offering a "preferred interpretive scheme" for what is occurring, or a viable interpretation of the new reality and to influence stakeholders and constituents to adopt it as their own" (Gioia & Chittipeddi, 1991, p. 443).

> *Snapshot: During a meeting with an architect, she and I pored over feedback scribbled by teachers directly onto a copy of some early plans for their school. As we tried to make sense of the (at times brutally honest) feedback it became clear that the principal's decision to put a copy of the plans on a table in the staffroom and inviting teachers to 'give feedback' hadn't really worked. What was clear from the comments was that the process hadn't provided them with enough 'sense-giving' to provide quality feedback. It appeared that they didn't really understand what they were looking at, nor where they were in the design process.*

How leaders work with resistance to change is also crucial in ensuring a change initiative is successful. While providing participants with opportunities to shape and contribute to the change process will likely minimise resistance to change, the presence of resistance should not necessarily be seen as bad. The traditional characterisation of resistance has been "overwhelmingly negative", and interpretations of it have been "decidedly one sided, in favor [sic] of change agents and their sponsors" (Ford, Ford, & D'Amelio, 2008, p. 362). Resistors are often labelled 'laggards' or 'squeaky wheels' with people asserting the best approach is 'don't water the rocks' or ignore resistance entirely.

Recent research tends to paint a more nuanced picture suggesting that concepts essential to ongoing improvement such as 'positive deviance' (and innovation in general) should be viewed as positive forms of resistance to the dominant narratives within organisations. They are both forms of healthy disobedience that question the status quo and take the organisation closer to achieving its goals.

While resistance to change can be "irrational and self-serving" (Ford, Ford, & D'Amelio, 2008, p. 100), how a leader responds to it is crucial for two key reasons. Firstly if 'resistors' to change are treated unfairly or unjustly in the process of 'stamping out' their resistance, change agents risk damaging the likely success of the change by violating observers' notions of fairness and justice (Aiken & Keller, 2009). Secondly, if change leaders don't view resistance as feedback, they may miss opportunities to reflect on how their own actions and inactions may have contributed to the occurrence of the resistance itself. Heifetz & Linsky (2002) suggest that change leaders may want to consider the absence of conflict or resistance to change as a sign of disengagement and a "harbinger of future problems resulting from unthinking acceptance" (Wegener, Petty, Smoak, & Fabrigar, 2004).

PHASE THREE: SUSTAINING CHANGE

Having done the hard work of implementing a change and supporting shifts in practice, many leaders may feel tempted to believe the trickiest part is over, and that the change will continue without much effort. They may "[declare] victory too soon" as Kotter says (1995, p. 66). Until change sinks down deeply into the culture of an organisation, new approaches are "fragile and subject to regression" (Kotter, 1996, p. 13). In fact, one of the most well-known adages about organisational culture is that it 'eats strategy for breakfast'. No matter how well planned and executed a change (or any other) strategy is, the culture of the organisation will determine whether a change is adopted, adapted or abandoned.

> *Snapshot: Working with a leadership team to review their reinforcement systems, we realised that the job descriptions they were using to hire new staff hadn't been updated since the change initiative began. What was going into newspapers and out onto the web were advertisements seeking people with the skills required for the old way of working, not the new. They were filling their organisation with people who were skilled at the practices they were trying to leave behind.*

Organisational culture can be defined as "a complex pattern of norms, attitudes, beliefs, behaviors, values, ceremonies, traditions, and myths that are deeply ingrained in the very core of the organization" (Barth, 2002, p. 6). Put more simply, culture is "the way we do things around here" (Barth, 2002, p. 6). In order to ensure that a change is not 'fragile and subject to regression' leaders can make practices part of the culture of their organisation by employing what Barth (2002) calls "embedding mechanisms". These can include:

- What leaders pay attention to, measure, and control on a regular basis
- How leaders allocate resources
- Deliberate role modeling, teaching, and coaching
- How leaders allocate rewards and status
- How leaders recruit, select, promote, and excommunicate.

Conclusion

When moving through the stages of a significant change implementation such as a transition to ILEs, school leaders should ensure that these essential elements of a successful change process are in place. Without ensuring the change is well supported, a project may have a well-designed facility but not the people who are capable of using that facility to its full potential.

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Leveraging teachers' lived experiences of inhabiting educational design

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Abstract

Learning environments are complex entities with the potential to mediate the human experience of being in the world. And yet, there is a scarcity of foundational knowledge about how teachers themselves perceive, engage, and adapt to new and innovative learning environments. Teachers at the intersection of innovations in design and practice need new tools to leverage their experiences of inhabiting educational design. This paper describes patterns of interaction identified through the Educational Design Intentions (EDI) model and the SPOT© photo-elicitation device. Ten teachers at two schools in Helsinki, Finland took 276 photographs and self-selected 100 for discussion at photo-elicitation interviews. Analysis identified the importance of teacher agency and the efficacy of design choices to support teachers' life and work at school. hen a balance exists between teachers' experiences and the design of learning environments, teachers are more likely to engage in meaningful ways with innovative spaces and pedagogical potentialities.

Keywords

INHABITATION | SPATIAL PEDAGOGIES | LEARNING ENVIRONMENTS | LIVED EXPERIENCE | VISUAL RESEARCH METHODOLOGIES

Introduction

Alexander, Neis, and Moore Alexander (2012) describe the purpose of architecture as creating built environments that intensify life. To accomplish this task, the authors suggest, "We must search for details of life as it is lived—as it is experienced" (p. 115). Further, Alexander (2003) argues that judgments about the quality of architecture necessarily originate from direct human observation and feeling. Only when subjective experience is also counted as a valid instrument of measurement can built environments enhance the life and work of their inhabitants.

Learning environments come alive when inhabited by students and teachers. The experience of living with and through places of learning animate innovations in teaching, learning, and design. However, the complex and myriad ways in which students and teachers inhabit new and innovative learning environments (ILEs) is largely unexplored. How do students and teachers themselves perceive, engage, and adapt to learning environments? How do we measure the impact of design on human thoughts, feelings, and actions? What counts as evidence?

The act of inhabiting a space invites lived experience into conversations regarding the efficacy of learning environments. As an analytic lens, *inhabitation* captures the affective and experiential dimensions of how school spaces actually function and how they are transformed into meaningful places. Such evidence is needed to guide investment in the design of educational environments and experiences that resonate with the lives and work of students and teachers.

In 2012, supported by the Social Sciences and Humanities Research Council (SSHRC) of Canada, I undertook an in-depth qualitative, phenomenological, multiple-case study to explore students', teachers', principals', and architects' experiences of designing, living, and working at two comprehensive schools (Grades 1–9) in Helsinki, Finland. The schools were identified in consultation with Reino Tapaninen, Chief Architect at the Finnish National Agency for Education, to reflect a diversity of exemplary learning environments and pedagogical practices. School A was a new build. School B involved a renovation of an existing building and a later addition. Both schools were designed to accommodate 500–600 students and were completed in 2009. This study was undertaken three years post-occupancy to allow time for the schools to develop and for students and teachers to experience spaces over time.

Evidence of the impact of space on experience was elucidated through the use of the Educational Design Intentions (EDI) model, a novel spatial-pedagogic framework that facilitates the identification, organization, and interpretation of contextually complex data from multiple sources. The EDI model positions a discussion of tensions (areas of fit and misfit) within educational design intentions (vision, aims, specific goals) and their implications for people, place, and pedagogy. Applied in conjunction with SPOT©, a unique and complex photo-elicitation device specifically designed to gather data on how students and teachers inhabit learning environments, this methodological orientation generates reliable patterns of interaction between the intended and actual use of learning environments.

This paper draws on the experiences of 10 teachers who participated in my doctoral research. Over the course of one week, teachers took 276 photographs of interior and exterior school spaces that reflected supportive and/or constraining elements of their experiences of inhabiting each school.

Using a camera can be an empowering experience. When teachers take photographs to capture and communicate the narrative of their lived experiences of inhabiting educational design, they are active participants in the research rather than passive subjects of study (Moreland & Cowie, 2005). The photo-elicitation device developed as part of this study was piloted with students in Iceland (Peterson, 2009). Intentionally designed to operate at a distance from the researcher, SPOT allows participants the freedom to take personally relevant photographs, affords an opportunity for participants' priorities to emerge by shifting the locus of power to participants, invites creative ways of undertaking the research task, and encourages the co-creation of knowledge.

Integrating photographs into the interview process produced a high-quality, multi-dimensional data set that reflected the complex temporal and social-emotional context of participants' embodied experiences. In preparation for individual photo-elicitation interviews, teachers self-selected 10 photographs they wished to discuss. No selection criteria were provided as each person had their own reasons for taking and choosing particular photographs. A total of 100 photographs were discussed.

The following sections describe how teachers' experiences of inhabiting open learning environments and staffrooms can be leveraged to enhance the fit between design choices and teaching, learning, and life at school. This is followed by a brief discussion of the role of teacher agency in facilitating a good fit between intended and actual use of learning environments. Direct quotations are annotated by participant (T=teacher) and research site (A=School A, B=School B). All Figures are participant photographs.

Inhabiting Open Learning Environments

When a balance exists between teachers' embodied experiences and the design of learning environments, teachers are more likely to engage in meaningful ways with innovative school spaces and

pedagogical potentialities. Understanding the complexities involved in the creation and maintenance of this dynamic balance has profound implications for design, use, and on-going evaluation of learning environments. Teachers in the study identified innumerable examples of design choices that both supported and constrained their ability to adapt/utilize school spaces over time.

Educators and architects jointly defined the **intention** *openness* as (a) providing natural light and views, (b) a way of nurturing relationship skills and a sense of empathy through the chance to see each other and school activities, and (c) supporting school safety by eliminating secluded spaces. As Figure 1 illustrates, a sense of openness was achieved by building floor-to-ceiling glass walls between classrooms and between classrooms and common areas.



Figure 1. Teacher photograph: "Interior glass walls were used to create open learning environments". (Source: Peterson, 2015).

Teachers' experiences of inhabiting open learning environments varied. One teacher described, "At first I thought it's weird to have this kind of aquarium here" (T/A). With time, however, many teachers came to enjoy working in these spaces and described becoming more aware of the needs of neighbouring teachers and their own classroom management strategies. This led to considerate behaviours, such as negotiating the placement of student art and work on shared glass walls and the scheduling of distracting activities such as movement games, singing or the showing of videos. Such mutually supportive interactions exemplify how a greater sense of collegiality can be supported by design, as the following example illustrates:

> *If I have a difficult lesson, I can take one look at Noomi [neighbouring teacher]—the pupils don't even see it—and she knows exactly what I mean. We call this collegial eye rolling. So you kind of have the support of another adult. Even though she's not here [in my classroom], we communicate a lot. I go there or she comes here. We don't really have to make an effort. We kind of automatically help each other all the time.*
>
> - (T/A)

Double doors in the middle of the glass walls separating classrooms made it easy to create a larger teaching space and opportunities for teacher collaboration. One teacher explained how combining classrooms also afforded an opportunity for teachers to model effective ways of working together such as the importance of cooperation and compromise. The following quote further illustrates how open classrooms reduced a sense of isolation and fostered greater interaction between teachers, which, in turn, supported pedagogy and the development of a professional community within schools:

There are buildings that don't make working together very easy and then there are buildings that have been designed for cooperation. I think that the better we get to know each other, the more we work and teach together, the more relaxed we get in one another's company. This way we are not so stressed and defensive about our teaching. Everything becomes more flexible and, as a professional, mentally I kind of breathe freely.

- (T/A)



Figure 2. Teacher photograph: "Limited 'solid' wall space resulted in the overlap of old/new technologies". (Source: Peterson, 2015).

At the same time, multiple **tensions** ensued when classrooms featured few or only one solid wall on which equipment (blackboards, whiteboards, Smart Boards, and document camera screens) could be installed. As Figure 2 demonstrates, it was impossible to use large parts of the white/blackboards or the Smart Board, when the screen for the document camera was extended. As a result of these constraints, students frequently sat facing the board or the screen. Alternative student seating arrangements were rarely used because they were out of scope with necessary technology or activities in neighbouring classrooms were too distracting. Teachers expressed a lack of comfort with the pedagogical implications of being anchored to one place.

"The teacher's place here is very hard for me because you can't have the same connection with students just standing at the front"

- (T/A).

Limited solid wall space also resulted in fewer areas to display student work. As such, glass walls were frequently used to "proudly show what the students have done [and] to decorate the classroom in a way that students feel like it's their homeroom" (T/A).

Teachers commented how it was stressful to live with these incompatibilities on a daily basis and hoped their experiences would help find design solutions that would alleviate these tensions.

Inhabiting the Staffroom

Teachers in the study also described how the design of related school spaces–meeting rooms, storage areas, and workspaces–influenced their personal and professional lives. Staffrooms were of particular importance. Besides providing essential elements such as lockers, mailboxes, washrooms/showers, a kitchen area, and a variety of seating options, teachers experienced their staffrooms as important places to engage in academic and non-academic discussions with colleagues and as places in which to reflect and organize the day's activities. They were also experienced as one of few, often the only, places to relax and socialize with others.

Every teacher photographed and discussed the kitchen areas in their staffrooms. Kitchen areas at both schools were approximately the same size and each was equipped with a kettle, coffeemaker, refrigerator, dishwasher, cupboards, a Finnish-style dish drying cupboard above the sink, and places for organic waste and recycling (see Figure 3). While staffroom kitchens were well equipped, the design of these spaces did not account for multiple users' needs to access shared equipment simultaneously during short periods of time before, after, and between classes. "We are 65 teachers and the kitchen area is only a little bigger than what I have in my flat. And I live on my own" (T/A). Another teacher described, "They put everything in the same place. If there are even ten teachers, you know [laughter], trying to get some coffee or make tea in the few minutes we have, it's really annoying" (T/B). Teachers were further frustrated by the fact that staffroom kitchens contained only one of each appliance for such a large number of people. "There's only one microwave and about half of us use it every day. So sometimes we are queuing for the microwave. Why can't we get a second one?" (T/A).



Figure 3. Teacher photograph. "Staffroom kitchen designs can cause disorganization and stress". (Source: Peterson, 2015).

Staffroom kitchens at both schools were experienced as cluttered and difficult to use in the limited times available. Small things that annoyed teachers on a daily basis had a disproportionate impact on lived experience and created stress in a space intended to provide an opportunity to rest and recharge throughout the day.

> *I like to have everything kind of organized because it helps me to control the inner chaos. If I come from a lesson and my mind is a mess and then the kitchen is a mess, it makes me feel much worse.*
>
> - (T/B)

When teachers are stressed, their ability to engage with each other and educational activities is unnecessarily compromised, as one teacher expected.

Teacher Agency

When the ability to alter or modify learning environments is constrained, teacher agency is diminished. Teachers at the participant schools described multiple instances in which their attempts to affect change in their teaching environments was limited by a surfeit of government or school board requirements and a host of unwritten rules of obscure origin adopted over time. The following section explores the impact of a lack of teacher agency.

At School B, teachers were told that glass walls between classrooms/common areas were to be kept clear at all times to preserve the intended 'open' design. As one teacher described, "[We were instructed to]… take everything off the glass walls. I don't know why. I have all kinds of nice pictures and now I have to take them

down. It doesn't kill anyone, but it kind of kills anyway" (T/B). This requirement left teachers with limited space to display student work or any way to accommodate the needs of students who found it difficult to work in such an open environment. In spite of this requirement, teachers once again started to use the glass walls to display student work and to create less distracting learning spaces (see Figure 4).

Another example of a lack of teacher agency related to attempts to augment classroom environments with soft-seating options (sofas and oversized pillows). Soft furnishings were valued to the point that some teachers



Figure 4. Teacher photograph: "Glass walls used to display student artwork and/or covered to reduce visual distractions". (Source: Peterson, 2015).

were willing to bring such items from home or to purchase them for their classrooms. However, their efforts were thwarted by fire code restrictions and rules governing the overall aesthetic of the school. As the following quote illustrates, teachers' inability to bring about change in their immediate environments was keenly felt and engendered a feeling of helplessness.

> *I try to keep the classroom as cosy as I can. I have a nice chair that I could bring, but it's against the rules. You mustn't take any sofas or something from outside because they have to be fire safe and the architect will say no. When I was a young teacher, I filled my classroom with sofas and plants and everything. But not now, not anymore, my room is very plain. You get more passive when you get too many no's or too many rules.*
>
> - (T/A)

Restricted use of highly desirable school spaces also reflected a lack of teacher agency. For example, both schools featured centrally located courtyards (see Figure 5) intended for use as outdoor learning spaces and as less-hurried places in which to relax and connect with nature.



Figure 5. Teacher photograph: "Courtyard with sculpture". (Source: Peterson, 2015).

One of the courtyards featured a much-appreciated tall metal sculpture of a flower (see Figure 6). "It looks like a dandelion from far away. But, when you get close, you realize the flower is made up of letters of the alphabet. … I really like that" (T/A). Another teacher described how the courtyard and stylized flower "… makes me feel that children are important, and we, who work here … have a good and essential task" (T/A). Regrettably, however, these highly visible, inviting courtyards were rarely used. One teacher commented, "You can't be there. It's locked. It should be open. I don't know what it is meant for but it's not used" (T/A).



Figure 6. Teacher photograph: "Flower sculpture". (Source: Peterson, 2015).

In spite of these limitations, participants were strongly attached to the inherent potential of courtyard spaces irrespective of their ambiguity of purpose, restricted access, limited functionally as outdoor teaching and learning spaces, unclear rules, and narrow links to curriculum. Teachers were able to see beyond the currently underdeveloped and underused courtyards and imagine them as meaningful places to relax, eat, play, and learn.

Leveraging Teachers' Lived Experiences

The inhabitation of learning environments is a complex phenomenon and, yet, students and teachers are not used to being asked about their experiences even though they are aware of and sensitive to the use/misuse of space; interested to share their thoughts and feelings; and have many suggestions regarding ways to improve current and future school design. The Educational Design Intentions (EDI) model and SPOT photo-elicitation tool enables teachers to describe the impact of design on their daily lives and illuminates patterns of interaction, large and small, in the dynamic relationship between people, place and pedagogy.

Evidence-based feedback loops (within and beyond schools) are essential to the sustainable evolution of new and innovative environments for learning. This study contributes to the development of a common language

through which to (a) identify shared goals, (b) leverage experiences of fit, (c) delineate concerns, and (d) articulate strategies to prioritize, resolve or mediate areas of misfit. In this way, teachers are empowered to more fully engage with learning environments.

Participation in this study also offered teachers the opportunity to develop new ways of 'seeing' their schools through which both were transformed. One teacher movingly communicated the importance of such insight as follows:

> *I liked very much to be able to participate [in this study] because it makes me more aware of where I am and it makes me think about this environment. I really saw the light when I understood that my feelings move very strongly according to these kinds of things [school design]. I hadn't been aware of it. Now I know that there are so many elements around you that work on so many levels. It's amazing!*
>
> - (T/A)

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Lessons from a seasoned furniture whisperer

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Abstract

Even the most future-focused schools typically purchase too much furniture, furniture that is too heavy and serves a single purpose. This redundancy limits flexibility, reduces movement, reinforces the prevalence of teacher-led instruction and impacts the ability for teachers to do well when transitioning from traditional classrooms to innovative learning environments. Before initiating any planning effort, we spend time in existing learning environments observing how time, space, furniture and technology are currently deployed. These observations now number in the thousands across 6 continents, 9 countries and 38 US states. From these observations and workshops, we have developed the expertise of "furniture whispering"- resulting in dramatically transformed learning environments with little effort. Five key principles include: reduce the educator footprint, reduce the casework, shift the technology and share it, count the seats and change the scene. Schools embracing these principles are spending less on furnishings and discovering greater flexibility in their learning environments.

Keywords

FLEXIBLE | FURNITURE | TECHNOLOGY | TEACHING

INTRODUCTION

Even the most future-focused schools typically purchase too much furniture, furniture that is too heavy and serves a single purpose. This redundancy limits flexibility, reduces movement, reinforces the prevalence of teacher-led instruction and impacts the ability for teachers to do well when transitioning from traditional classrooms to innovative learning environments.

Our work with school leaders including administrators, directors, trustees, and educators focuses on building their knowledge and capacity to design learning environments that support technology-enhanced learning in collaborative learning environments.

LITERATURE REVIEW

There is a growing body of research demonstrating the important impacts the physical classroom environment has on students' academic performance (Cheryan, Ziegler, Plaut, & Meltzoff, 2014). The way a classroom is designed and set up, and how that learning space functions, plays an essential role in how a student can access learning and how motivated they are in that environment (Cheryan et al., 2014).

Thornburg (2014) purported that the ultimate learning environment creates a balance of direct instruction, conversation and discussion with peers and places for application and reflection. In order to foster such learning spaces, the educator must be able to design these learning spaces for optimal utilization. This attention on the physical classroom environment and how it impacts student performance has provided a platform for

professionals to discuss the redesign of learning environments with the purpose of education driving those discussions. Perkins and Bordwell (2010) discussed that not all changes require a construction response, "school building programs should be driven by curriculum, teaching, and learning needs" (p. 121). A low-cost solution to building new brick-and-mortar solutions includes redesigning spaces, revising class schedules, improving the sharing of resources (Perkins & Bordwell, 2010). The growth of diversity in teaching and learning styles has influenced the design of multifunctional learning environments, products and furniture built to be flexible and easily adaptable to different special configurations, and equipment appropriately defined for every space (Perkins & Bordwell, 2010). This includes building additional flexibility within the classroom area such as moveable and demountable walls, shared spaces with moveable resources, and spaces designed for the use of various technologies, anywhere at any time (Perkins & Bordwell, 2010). The creation of shared learning spaces has "evolved to be interdisciplinary centers that personalize learning for individual, diverse learners in collaborative settings", that when effectively designed, create communities that contextualize learning around the goals of the participants (Bonine et al., 2018).

"To provide students with the education they need to thrive in a globally connected world, we must find ways to design, fund, acquire, and maintain the infrastructure that will make connectivity a reality for every teacher and student in every classroom" (United States Department of Education, 2014, p. 6). The US Department of Education (2016) stated that for Future Ready Leaders to build Future Ready Schools they need to be able to create and sustain a culture and conditions for innovation and change by embedding "an understanding of technology-enabled education within the roles and responsibilities of education leaders at all levels and set state, regional, and local visions for technology in learning" (United States Department of Education, 2016, p. 39). School leaders must possess the capacity to develop, implement, and support a robust infrastructure and enhance the use of space and time. Leaders are partnering with experts in the field to build this capacity.

Themes that emerged in the literature related to classroom and learning environment design included time, space, furniture, and technology. However, there seemed to be a gap in the research in how these areas compare in the actual implementation in the learning environments in different countries and what implications that research would have for practitioners in the field. This project aimed to study existing learning environments for these areas and provide recommendations for practitioners

RESEARCH DESIGN

Before initiating any planning effort, we spent time in existing learning environments observing how time, space, furniture and technology are currently deployed. We have gathered this information in nearly 6,000 learning environments in more than 300 schools around the world. Data was gathered in a common format using the Collaborative Learning Observation form, and then the information was presented as a summary of current educational practices before conducting a deep dive into desired future educational practices with teams of learners, educators and community members.

TIME

The Collaborative Learning Observation included a review of the daily bell schedule, weekly schedule and annual calendar. This review included answering the following questions:

- When does the school day begin and does it begin at the same time for all students and adults? How is the day divided, and does it allow adequate time for deeper learning/hands-on/active learning?
- How do individual teachers or teacher teams structure the time they have to work with learners such as direct instruction, small groups, working at own pace?

- Do teachers work alone or in teams?
- Does the school day include common planning time for teacher teams?
- How is time organized over the course of the week, for example does it vary from day to day (for example more structured on Monday and less structured on Friday?
- How is the annual calendar organized: does it include many breaks of 2 weeks or less or a long break of 2-3 months?
- What is the impact of short or long breaks on learning?

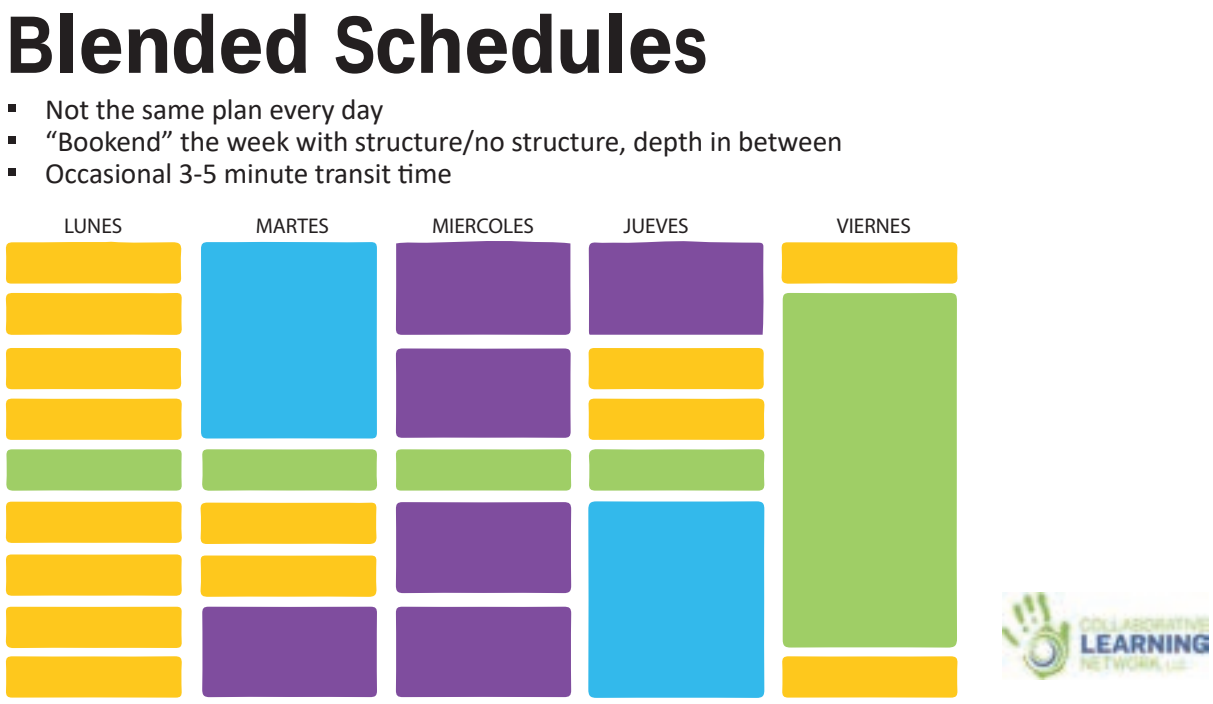

Figure 1. Example of Blended Schedule illustrating variety over course of week. (Source: https://www.collaborativelearningnetwork.com).

SPACE

The Collaborative Learning Observation noted the size (varies from 650 SF/60 SM to 1200 SF/110 SM) and proportion of the room (square or rectangular or other) by answering the following questions:

- How is the room configured? "Teaching wall" on short wall or long wall? (far from many learners or near to all learners)
- How much space is allocated to the teacher? (often 1/3 or more of the room)
- How much is allocated for built-in storage? (often 50 SF/5 SM)
- Sinks? Acoustics?
- Daylight? Electric Lighting?



Figure 2. Kempsey Adventist School Innovation Lab, Kempsey, NSW (AU). (Source: Authors).

FURNITURE

The Collaborative Learning Observation captured the quantities and types of furnishings within a learning environment by answering the following questions:

- How many learners are typically in the learning environment at one time?
- How are furnishings organized – column and rows facing one direction; small groups??
- What types of furnishings : chair/desk combinations; tables, light enough for learners to move?



Figure 3. Typical organization of furnishings in columns and rows, Avondale Adventist School Collaboration Space, Cooranbong, NSW (AU). 2018. (Source: Authors, 2018).

TECHNOLOGY

The Collaborative Learning Observation captured the types and distribution of technology within each learning environment by answer the following questions:

- How is technology deployed – one interactive surface; video?
- Who controls the chalk - 1:1; 3:1, 1:3; by choice or by budget?
- Technology holidays?
- Tablets? Laptops? Desktops?
- Shared with adjacent learning environments?
- Computer labs?
- Installed over white board over chalk board?

FINDINGS

TIME

Modifying the daily timetable and annual calendar appeared to be the quickest path to creating longer blocks of time for deeper learning in traditional and innovative learning environments. The Kansas Department of Education (Kansas State Department of Education, 2015) launched a redesign of the teaching and learning in seven "moonshot" schools, nearly all of which have immediately eliminated the traditional 7 or 8 period day and replaced it with interdisciplinary blocks of time (Kendle, 2018). Parris Gibson Alternative High School in Great Falls, Montana (US) has no daily timetable beyond a brief check-in with an advisor at the beginning and end of the day.

SPACE

Traditional educational facility specifications continue to establish common standards for similar-sized general-purpose educational facilities based on models of educators working alone, each with independent needs for storage of educator personal items and educational material storage, water, technology. The Ohio Facilities Construction Commission retains standards like those noted above, while encouraging varied learning environments surrounding extended learning areas with shared storage, planning centers and support staff.

FURNITURE

Schools in the Chicago, Illinois (US) area continue to be challenged by traditional thinking about teaching and learning, including requiring that each educator has two large (3x6 FT/1x2 M) desks in each learning environment. The result of these policies is that innovative learning environments in Steger, Illinois were smaller than conventional spaces (650 SF/60 SM) but were required to dedicate 150-200 SF (14-19 SM) or more to the educator presence, or 30% of the learning environment. This same facility included an extended learning area and an unused planning center for educators. The Kempsey Adventist School, NSW (AU) completed a series of innovative learning environments with a wide range of flexible furnishings in 2016 & 2018. The quantities of furnishings purchased in 2016 limited flexibility in the use of those learning environments. The new facilities accounted for approximately 10% of all facilities on campus, allowing excess furnishings to be redistributed to traditional learning environments elsewhere on campus. Garden City Montessori in Missoula, Montana (USA) intentionally provides seating for only 1/3 of the entire school, reinforcing the expectation that using the floor, standing, or learning in motion should be the norm.

TECHNOLOGY

Although many schools around the world have launched 1:1 technology initiatives, we observed considerable variation in those efforts. For example; some communities achieved 1:1 distribution with inclusion of learner-owned devices; others developed elaborate policies excluding the use of learner-owned devices. In the small (577 learners K-12) community of Colstrip, Montana, tablets and laptops were signed out to each learner each morning and collected at the end of each day. In the Colstrip High School of 200 learners, this effort took approximately 45 minutes of each day. In the similarly small (722 learners K-12) community of Eureka, Montana, devices were assigned to each learner at the start of the school year and returned at the end of the year. Each device included an insurance policy of $20. If a learner was not able to pay that sum, they were given the opportunity to work for the school in lieu of payment with such tasks as cleaning learning environments or working in administrative offices.

DISCUSSION

These observations now number in the thousands across 6 continents, 9 countries and 38 US states. From these observations and workshops, and the collection of data for common indicators, we have developed the expertise of "furniture whispering"- resulting in dramatically transformed learning environments with little effort. The five key principles that emerged from our findings include: reduce the educator footprint, reduce the casework, shift the technology and share it, count the seats and strike the set. Schools embracing these principles are spending less on furnishings and discovering greater flexibility in their learning environments.

WHISPER PRINCIPLE #1: REDUCE THE EDUCATOR FOOTPRINT.

A typical 900 square foot (84 SM) classroom in the United States allocates 100-150 square feet (10-14 SM) to the teacher desk, often located adjacent to the only window in the room. Reducing the educator footprint begins with creating a nearby teacher planning center. The planning enter not only increases collaboration with peers, it also results in a place to secure personal items and reduce the classroom footprint of the educator to

a portable kiosk on casters. If that same kiosk is height adjustable and includes a wireless microphone, every learner in the room can be given access. One consequence of "ownership" of learning environments is that teachers feel obligated to solve all the problems of the universe in their similarly-size box. These learning environments include a sink, storage of occasionally used classroom materials, saturated wall surfaces, and a large teacher desk. The classroom storage and isolation of the educator reinforces hording of resources (paper, supplies, etc.) and occasionally inheriting and curating the horded materials of the prior occupant.



Figure 4. Educator Footprint equal to ¼ to 1/3 of learning environment, Dixon Elementary School, MT (USA). (Source: Authors, 2018).



Figure 5. Teacher Planning Center, Science And Math Institute (SAMI) at Tacoma Zoo, Tacoma, WA (USA). 2019. (Source: Authors, 2018).

ESSENTIAL QUESTIONS

We recommend that teams of learners, educators and community members review images and diagrams of their school facilities and consider the following questions:

Q1: Where could you create a visible planning center within your existing facility?

Q2: What does a planning center need (restrooms, food, furnishings, technology, etc.) for it to be actively used?

WHISPER PRINCIPLE #2: REDUCE THE CASEWORK.

Built-in casework is expensive, difficult to manage and limits the placement of "teaching walls" to often only 1 or 2 surfaces. An 8x24 (200 SF) 2.5 x 8 (19 SM) shared storage closet with floor to ceiling metal shelving can meet the same needs for 4-5 educators in a manner that is easier to supervise and occasionally purge. Storage units within learning environments should be open-faced cubicles on casters for shared trays, backpacks, etc. The cubicles can be used to shape spaces that are scaled to the occupants of the room.



Figure 6. Storage units, The Mont'Kiara International School, Kuala Lumpur, Malaysia. (Source: Laboski, 2017).

ESSENTIAL QUESTIONS

We recommend that teams of learners, educators and community members review images and diagrams of their school facilities and consider the following questions:

Q1: How does built-in storage limit flexibility in your learning environments

Q2: What items need to be accessed every day?

Q3: Where could you create shared storage within your existing facility?

Q4: How many people can share storage effectively?



Figure 7. Shared Technology, Odyssey Elementary School, Davis, UT (USA). (Source: Authors, 2018).

WHISPER PRINCIPLE #3: SHIFT THE TECHNOLOGY AND SHARE IT.

We have observed classrooms with interactive boards placed over whiteboards which cover original chalk boards. Those presentation surfaces are often on the "short" wall in a rectangular room, resulting in a few students with close proximity, and many with significant distance to the materials appearing on the presentation surface. Shift the presentation surface to the longest wall possible, resulting in close proximity for all. Ideally the entire 10x 30 (3 M x 10 M) surface is interactive and the technology is shared, not the realm of the educator. Laptop/tablet cars can be in an adjacent extended learning area, increasing space available for teaching and learning, reducing heat build-up in the room and reducing the overall technology budget.

ESSENTIAL QUESTIONS

We recommend that teams of learners, educators and community members review images and diagrams of their school facilities and consider the following questions:

Q1: How does sharing technology impact teaching and learning?

Q2: How do peers use technology to help each other with learning?

Q3: How does technology impact learner engagement?

Q4: What does learning look like during technology "holidays"?

WHISPER PRINCIPLE #4: COUNT THE SEATS.

Survey existing furnishings and confirm how many are in use at one time. A typical classroom for 20 often has 35 or more seating surfaces. Purge the least flexible furnishings. Retain variety of high and low and hard and soft. Soft furnishings should be approximately 10% of total. Set the expectation that furnishings are temporary places within a learning environment, so that no one is expected to sit on a stool or claim the sofa for more than 8-10 minutes.



Figure 8. Variety of seating surfaces: high/low and hard/soft: Innovation Lab, Kempsey Adventist School, Kempsey, NSW (AU). (Source: Authors, 2018).

ESSENTIAL QUESTIONS:

We recommend that teams of learners, educators and community members review images and diagrams of their school facilities and consider the following questions:

Q1: What types of learning are taking place in our learning environments?

Q2: What types of furnishings are needed to support learning?

Q3: How do those needs change over the course of the day or week?

WHISPER PRINCIPLE #5: CHANGE THE SCENE.

Train people how to shift from presentation mode to individual reflection to small group discussion with no change to furnishings. Demonstrate shift to active learning and from active learning to celebration of learning. These changes can take place in 1-10 seconds and not be disruptive to the flow of learning.

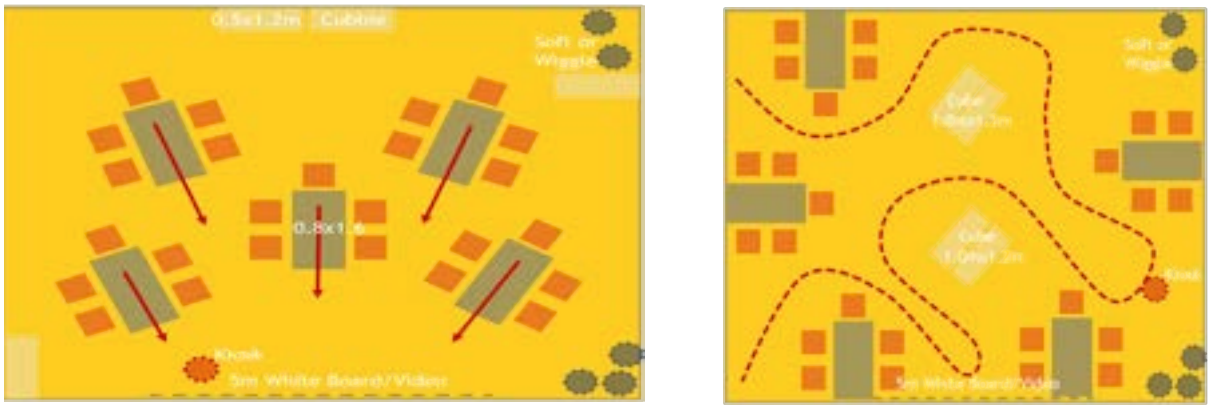

Figure 9. Diagrams illustrating changes to furnishings to support many learning modalities: Presentation mode (left), and Celebration of learning (right).

ESSENTIAL QUESTIONS

We recommend that teams of learners, educators and community members review images and diagrams of their school facilities and consider the following questions:

Q1: How quickly can furnishings be relocated to support presentations, reflection, small group discussions, small group work, active learning and celebrations of learning?

Q2: What types of training is needed to make those changes in less than 30 seconds?

CONCLUSION

Schools that embrace these principles are addressing the themes that have emerged in the literature that should be focused on to build flexible, adaptable, and collaborative learning spaces, spending substantially less money on furnishings and discovering greater flexibility in their learning environments.

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The teachers' and students' perceptions about inclusion through innovative learning environments

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Abstract

The objective of our ongoing exploratory research is to understand whether the organisation of learning spaces is beneficial for the inclusion of all students, especially those with severe learning disabilities. The research has been conducted in six different schools, which range from primary to secondary schools, four of them are in Italy and two in Denmark. Several techniques have been used for data collection: maps and documents; videos and photographs; geometric and photographic surveys; direct observation of the school premises, objects and interactions; group and individual interviews with principals, teachers and students. The research has highlighted that teachers in inclusive schools are more aware of the organisation of the learning spaces and the flexible and changeable setting enables inclusion, multiple teaching strategies, learning individualisation and an educational community.

Keywords

INCLUSIVE EDUCATION | DESIGN FOR ALL | DISABILITY | AUTISM | INCLUSIVE LEARNING SPACES

Introduction

The continuous evolution of didactic models, for different educational needs emerging from society, has highlighted how the current spaces of the majority of schools are now obsolete. New paradigms and a new vision of the learning environments are necessary for allowing all the students, no one excluded, to improve their learning and consequently their skills.

Each educational space should be designed to encourage positive learning for all students, including those with impairments, that are often turned away from the class and their classmates. In an inclusive vision of the school, each student must be guided to learn as widely as possible in class (Gaines, Bourne, Pearson & Kleibrink, 2016).

The challenge is to be able to design and implement flexible solutions that make it possible to adapt spaces according to the different educational solutions and to the special needs in existing schools, with restructuring measures having a low economic impact. An interdisciplinary work is necessary to face this, supported by an inclusive commitment shared by the professionals of the different areas of intervention.

In designing learning environments, architects, designers and facility managers must consider the needs of all students and plan together with the members of the school community. Often it is necessary to refer to many perspectives to find suitable solutions (Marcarini, 2016). Many designers refer to: the Field Theory (Lewin, 1936), that relates the surrounding environment to behavior; the Environmental Preference Theory (Kaplan, Kaplan, Kaplan, & Brown, 1989) that values the environmental qualities on the bases of some characteristics such as consistency and complexity in order to create environments that increase the comfort of the people who live there; the Theory of Legibility (Lynch, 1960) that allows to identify spatial solutions that help people with difficulty of orientation to identify a path; the Prospect and Refuge Theory (Appleton, 1975) which explains

the ways used by man to organise the environment around him; the Sensory Integration Theory developed by Fisher, Murray, & Bundy (1991) starting from the research work by Jean Ayres, which studies the use of sensory information to help people interact with the environment; the Gestalt Theory used to understand how individuals organise their perception in interacting with environments (Bogdashina, 2003) and also the Theory of Mind, the Additional Theoretical Work, the Theory of Executive Function and the Therapeutic Environment Theory (Gaines et al., 2016).

The different contributions should however be integrated within a theoretically coherent framework that has, as its cardinal principles, the enhancement of the potential of each person, even if with severe impairment, and the construction of an inclusive context based on mutual respect and co-evolution (Canevaro, 1999; Sandri, 2014).

Most of the existing literature about inclusive architecture focuses on sensory and spatial issues and presents some recommendations on what the most significant aspects of spatial layout are for helping architects to design environments appropriate to disabled people (Mostafa, 2008).

The research that has been carried out gives indications to design new schools with adequate spaces, for the needs of people with disabilities in general and with autism in particular, evidencing a very close relationship between educational spaces and performance (Khare & Mullick, 2009). However, the inclusion "for all" is a complex process to be implemented and can be conceived as a regulatory instance of utopian value that owes its effectiveness to being continually optimised (IO2 Training Tools, 2018).

Italy has a forty-year tradition of inclusion of all students with disabilities in regular classes, but in case of necessity, in many schools, "support rooms" are used only for students with impairments. It is necessary to reflect on this situation, that marginalises some students, to find adequate solutions, in new but also in old schools, to improve the educational environments with low cost investments and to make them more inclusive, so that nobody is excluded.

The furniture and the spatial organisation should be a support to democratic (Dewey, 1916) and inclusive schools in which an active teaching methodology is implemented and aimed at increasing each student's responsibility, autonomy and communication, using differentiated teaching strategies (from direct education, to apprenticeships, to social constructivism) and according to the different learning characteristics of each one (Mitchell, 2014).

Research methodology

Based on previous reflections and starting from the analysis of the most recent literature, the following questions, that address this research, have been asked:

- How can inclusive spaces in schools be designed?
- Is it possible to organise a classroom so that all students can stay in class and learn in the best conditions?
- Can the creation of spaces ad hoc (soft or relaxed corner) inside the classroom guarantee and improve the inclusion of all children?
- Can open-plan schools guarantee and improve the inclusion of all children?
- Does the organisation of spaces and activities of the schools involved in the research (for instance "subject classrooms") promote autonomy, responsibility and well-being according to the definition of the International Classification of functioning, disability and health – International Classification of Function, Disability and Health (ICF) (WHO, 2001)?

The research focused on six schools, which define themselves as innovative schools and were available to collaborate, in two different countries: Denmark and Italy. The choice of Denmark was made for three reasons. The first concerns the investments made in the school after the poor results in the OECD-PISA 2000 survey (Juelkjær, 2012); the second reason pertains to the investments that involved the new schools design, where an innovative teaching method was proposed putting the student at the center of education with its different learning style (McGrane, 2012). The third is historical - since 1844 legislative measures were issued in Denmark giving importance to the influence of educational spaces on child development (Vindum, 2007).

The Danish schools involved in the research are: Hellerup Folkeskole in Gentofte (Copenhagen), for children aged 6 to 15, total open space, and Høsterkøb Skole in Hørshol, for children aged 7 to 11, that has reorganised the spaces to became more inclusive. The Italian schools are: "Rondelli" Primary school in Monzuno (Bologna), for children aged 6 to 10, in which the internal spaces have been reorganised, without any structural intervention; "Piersanti Mattarella" first grade secondary school in Modena, for children aged 11 to 13, built according to the latest legislative provisions and architectural indications. In addition, two high schools for students aged 14 to 19: Don Milani Institute in Montichiari close to Brescia, that is reorganising their learning spaces also to cater for the enrollment of numerous students with disabilities; Enrico Fermi Institute, in Mantua, where, some years ago the "subject classroom" was realised and it is interesting to verify how this organisation influences the inclusion of students with disability.

The schools are particularly illustrative for their characteristics, highlighting some similar project ideas: although they have different conceptions of inclusion1 and they are not comparable due to differences in the cultural, historical and social context of the two countries, all schools organised the spaces by referring to the socio-constructivist learning model. Some of them (Hellerup, Don Milani, Mattarella) are characterised by being the result of a shared design process with the teachers and by having important participation of families.

This research was carried out by adopting the ecological paradigm (Mertens, 2010), with a strong hermeneutic and orientative value (Mortari, 2012), and envisaged the use of qualitative survey techniques, such as the "Case Study", according to an inductive vision. This allowed us to reach a shared picture of the situation, safeguarding the features of real life events (Yin, 2003).

With regard to data collection, various search tools have been used (Silvermann, 2002): bibliographic research about the influence of the organisation of spaces to guarantee the inclusion of students with impairments, even severe; maps and documents provided by schools; videos, geometric and photographic surveys; collection of static and dimensional data; direct observation of school premises, of inclusive organisation of spaces and of didactic organisation; individual interviews and focus group with the principals, teachers and students, with or without special educational needs, to understand their belief and perception about how the different organisation of spaces can influence students' well-being and inclusion.

1 In Denmark, the legislation on special education can be organised in different ways. In most cases, the pupil remains in a mainstream school class and receives special education in one or more subjects as a supplement to general teaching. (...) Alternatively, they may be taught in a special class, either in mainstream or special school settings. Finally, the pupil may attend either a mainstream school class or a special class and be taught in both types of classes. (www.european-agency.org/country-information/denmark/systems-of-support-and-specialist-provision). In Italy, all the pupils with disabilities generally attend mainstream schools, in the ordinary sections and classes at all educational levels.

Discussion

The design of learning environments must consider human-environment interactions through Maslow's pyramid of needs (Maslow, 1954) which highlights how the need for privacy, personal spaces, isolation from crowding and the attention for the aspects related to sensoriality: sight, hearing, touch, proprioceptive functions and the vestibular apparatus are a priority. In particular, eyesight is the most important sensory organ and the most used by the population, but visual stimulation can be very disruptive for people with autistic syndrome. The characteristics related to eyesight are: light, in its declinations of natural/artificial light, glare, reflections and colors; the effects that derive are far beyond aesthetics. Studies on the effects of color on people show possible eye fatigue and changes in blood pressure and brain development (Gaines et al., 2016).

In space organisation, environments designed in a "legible" way according to Lynch's Theory of Legibility, compared to the activities that must be performed, allow people with disabilities to move safely, without wondering what activities and behaviors are most appropriate for that space. A method called "spatial sequencing" reorganises the space to promote routines that help people predict the activities that will be carried out in every environment and therefore to be less anxious.

From a hearing point of view, people with disabilities, in particular with autism, are influenced by noise that can cause reactions of various kinds even if the level of its acceptability varies from culture to culture. In any case it is important in the design phase to provide sound-absorbing materials that reduce noise and noise reverberation (Gaines et al., 2016).

All students, but especially those with disability, should find a space that supports their wellbeing and, if necessary, "take refuge" when they feel the need. The space should be equipped with minimal furniture, soft lights, relaxing music, comfortable cushions on which to sit, to allow stress reduction (Gaines et al. 2016). Also, in this case the design and architectural solutions are different in relation to the adopted principle of inclusion.

Results

Organisation of space influences the behaviours of humans in an 'invisible' way (Bernstein, 1979) through the 'latent pedagogy' (Bondioli & Nigito 2008) which is often passively accepted and experienced by teachers. In inclusive schools there is awareness of this influence and the flow of communicative authentic exchange (Rogers, 1951) between teachers and students helps to create a collaborative atmosphere, an educational community, and to overcome the fragmentation of disciplines.

The cornerstone, as all the members of the schools involved in the research confirm, is the relationship between the teachers and the students, but the "specific organisation of learning spaces" can facilitate an innovative, inclusive and individualised didactic practice where everyone learns in reciprocity and in well-being. "Well-being", as specified in the ICF (WHO, 2001), is not only the result of a state of health, but the possibility of feeling oneself as a person that contributes to their own community. All this involves the creation of distinct areas in the classroom for diversifying activities. A "soft or relaxed" space in the classroom, that we can call a "quiet area for inclusion" is present in all the schools involved in the research. In this space all students, especially when they feel over-stimulated, especially for students with Autistic Syndrome, emotional or behavioural problems, can find a space and time to be alone, if necessary for them, and to self-regulate (McLesky, Rosenberg & Westling, 2013). The "quiet area for inclusion" is a space in the classroom where regulated activities can be carried out also in small or large groups. It is based on the need to strengthen the sense of belonging to a community and the ability of students to exercise responsibility.

Every school involved in the research organises itself in different ways, but everyone tries to find a solution to guarantee the expression of students' potentiality and their inclusion through a flexible setting, the use of multiple teaching strategies and learning individualisation. We are briefly going to describe the different "quiet areas".

RONDELLI PRIMARY SCHOOL: "THE AGORÀ SPACE"

There are 80 students of which 7 (8.75%) have Special Educational Needs. The "Agorà" is a space in the classroom defined by a corner between two walls equipped with soft seats and hypoallergenic carpet.



Figure 1. Classrooms. (Source: Photos provided by teachers, 2018).

"Piersanti Mattarella" First Grade Secondary School: The "Island There Is"

There are 253 students of which 11 (4,34%) have Special Educational Needs. "The Island there is" is a space in the classroom separated by a wall or a piece of furniture. It is equipped with seats and comfortable cushions.



Figure 2. Classrooms. (Source: Sandri, Marcarini, 2018).

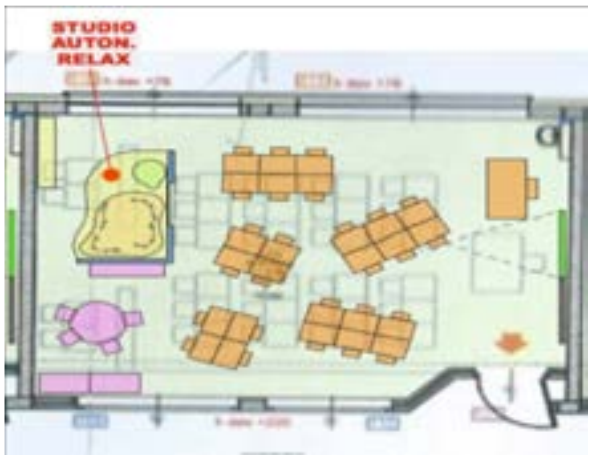

Figure 3. Mattarella -The island there is. (Source: Rivalenti, 2016).

"ENRICO FERMI" SECOND GRADE SECONDARY SCHOOL

There are 1660 students of which 12 (0,72%) have Special Educational Needs. Inside some classrooms there is a space equipped with comfortable seats.



Figure 4. Fermi-English Classroom & Quiet area. (Source: Paolino, 2018).

"DON MILANI" SECOND GRADE SECONDARY SCHOOL

There are 1750 students of which 31 (1,77%) have Special Educational Needs. Through the shared design process, the teachers and the students designed the classrooms as learning environments within which they think it is important to realise a private and inclusive space, where not only the students with disabilities, but all students can study alone or with a classmate or use for relaxing.



Figure 5. Don Milani-New classroom rendering. (Source: Filios & Arnaldi, 2018).

"HØSTERKØB» SKOLE PRIMARY SCHOOL "EVERYWHERE"

There are 212 students, of these 13 (6,13%) have Special Educational Needs: Autism Syndrome; ADHD (Attention Deficit Hyperactivity Disorder); OCD (Obsessive Compulsive Disorder). There aren't any spaces for children with disabilities or support teachers. Every space in the classroom can be suitable to help pupils who are in difficulty, but there are some quiet areas and spaces where the students can take a rest.

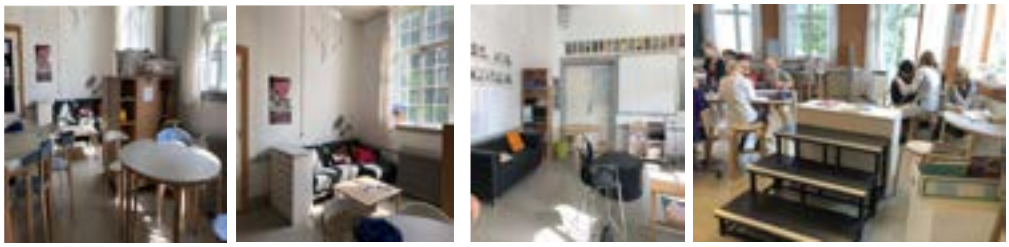

Figure 6. "Høsterkøb-Learning environments". (Source: Authors, 2018).

HELLERUP" FOLKESKOLE: "THE NORTH STAR"

There are 621 students, of which 24 (3,86%) have special education needs: 12 students have a certification: Asperger Syndrome, ADHD (Attention Deficit Hyperactivity Disorder); OCD (Obsessive Compulsive Disorder); 12 students have: Dyslexia, Dyscalculia, Anxiety and other learning difficulties. In Hellerup there isn't a specialised space for children with disabilities. There is "The North Star", «it is not a place or a special room, but it is a way to help children» (Headteacher of Hellerup, 2018).

The North Star is a function specifically for the younger students (from 6 to 10 years of age) with disabilities and for all students who at times need extra help by support teachers or pedagogues in their educational career or to find a quiet space in a specific room by the office.



Figure 7. Hellerup-The North Star. (Source: Marcarini, 2013).



Figure 8. Hellerup-Learning environments. (Source: Authors, 2018).

Conclusions

Spacious classrooms where the teachers may implement flexible and individualised didactics are an important aspect for inclusion. According to the perception of the interviewed teachers of Mattarella and Fermi schools, the new organisation in "subject classrooms" allowed all students and in particular those with disabilities to become "more autonomous and responsible".

All the presented schools want to reach, more or less explicitly, the constitution of a "scholastic space", of a "potential space" (Winnicott, 1989) where it is possible that pupils and teachers can relate to each other in terms of a "we" and they can co-build, each of them with their own different characteristics, in their own original identity, a community (Sergiovanni, 1994), where nobody is excluded.

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Spazi colore: A project for didactic innovation

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Abstract

The aim of the study is to experiment, in a relevant school context for Milan, the modification of learning spaces for the benefit of didactic innovation. The Manzoni Linguistic High School welcomes about 1400 students and 200 teachers. The collection of data is based on direct observation and surveys for teachers and students who use the three spaces already prepared (the "colour spaces"). The sample consists of students and teachers who have carried out structured activities in those environments. Direct observation has concerned the entire scholastic community that can still benefit from those spaces. The implications will impact the teaching in Liceo Manzoni and the supply of furnishings to the city schools by the Municipality of Milan. The key ideas are vision and practicality.

Keywords

VISION | CHANGE | SUSTAINABILITY | COLLABORATION

Premise

The deepest aspect of our experience, as city public administrators, lies in guaranteeing environments where the new educational challenges can be adequately carried out, with particular reference to Cooperative Learning.

> *"Municipalities and provinces have to warrant the quality of school buildings. Municipalities and provincial institutions - as promoters – need to […] know the challenges of training and support the educational and teaching activities by guaranteeing the pedagogical quality of the school buildings ".*
>
> - (Rete Spazio e Apprendimento, 2015, p.169)

Currently, 41,163 school buildings have been surveyed in Italy (MIUR, 2016); among these, 504 are under the direct responsibility of the City of Milan. This is where the educational experience of millions of students unravels. It's not possible to disregard physicality of school spaces, and their need to be redesigned, when imagining their transformation, or even under their current use.

This challenge unfolds on a double level:

- to define design and pedagogical theories capable of pre-figuring future models;
- defining conceptual approaches and operating methods capable of transforming the huge existing heritage.

Within this general framework we have redesigned some school environments of the "Alessandro Manzoni" Civic Pole encouraging shared and collaborative learning processes stemming from a reflection on teaching strategies that have the student and his/her needs at their core.

The project

The creation of the work arose from our participation with an Erasmus + program in Denmark at Ørestad High School in Copenhagen which has involved the School and Educational Services and the Digital Agenda Department of our Administration. The work stems from some mandates originating precise operative choices. The place to be allocated to the "Colour Spaces" had to be central to the layout of the school, in an easily accessible place, not far from the ordinary teaching spaces.

On the basis of meetings, inspections, planimetric evaluations and analysis of the real conditions of use, the "Margherita" has been identified as a suitable place. This name refers to a space with a circular plan divided into six segments that depart from a hexagonal technical area. These premises - traditionally intended to accommodate administrative offices and desk activities have an extremely interesting position: they act as a junction between the entrance from the street and access to stairs and corridors that distribute the classrooms, giving access also to the area that houses laboratories and the great hall.

Dimensions and capacity:

- We chose to use three out of the six spaces, identifying those facing the inside of the school, thus leaving the "slices" looking to the street entrance to desk activities.
- We included the only space (red today) with partially different geometrical features. It is not closed by perimeter walls and is smaller.
- Two rooms measure about 40 sqm (green and blue spaces) and one is slightly less than 30 sqm (red space). In total over 100 sqm, the "Colour Spaces" are potentially able - with a weekly two-hour rotation - to accommodate more than half of the students of the school.

Transparency: a high degree of transparency was respected as a reflection of teaching management, important for any collaborative teaching activity. Some essential elements have been eliminated, like doors and curtains. The removal of all visual shields between the outside and the inside of the spaces is the radical transformation of Jeremy Bentham "panopticon": it's not any more a single subject that watches over many; but there are many that can watch over everybody.

Furniture: we wanted to reach two objectives: one of identity and the other relating to the conditions of use. Through the furnishings (type, number and variable placement) some possible conditions of use have been proposed:

- Each room has 16 seats. The number is lower than that of a typical class because we did not intend to relocate the entire class group to a different context. The logic is that of decomposition and re-aggregation into smaller groups aimed at cooperative learning; the seats themselves are divided into two sub-groups (8 large cushions + 8 coloured chairs for each space). The cushions allow a relaxed and strongly "plastic" seat and are more suited for individual in-depth activities or for informal work done by small groups. The colourful chairs are around the circular tables or along the curved wall shelves (equipped with sockets to recharge the connectivity devices). In this case, the session is more appropriate for structured activities.
- Each space has a rather large shelving unit (two in the case of red space). The thought that guided this choice can be summarized in "exchanging objects, exchanging emotions"; while supporting digital education, we have not excluded the free exchange of books as a further register of sharing. The shelves are designed both for book sharing and as a place to accommodate objects supporting the activities carried out in the spaces
- Finally, two large chromatically coordinated lamps have been added to each room.

Colour: This is the key through which we have pursued the objective relating to the identity of the spaces: green, blue and red as elements of identity and variety. Through the use of colours, we wanted to achieve objectives and evoke different suggestions as in the work of the architect Luis Barragan (1902-1988):

- Green, red and blue are colours that span across time (vegetation, fire, sky) but also intrinsically within the technological narration of modernity: they are the colours of the RGB system whose specifications were described in 1936 by the CIE (Commission Internationale de l'Éclairage) and are at the base of the colours returned by screens and printers.
- Green, blue and red as elements of identity and variety: the three spaces are characterized by a coordinated color for the furnishing and the walls which constitutes a dynamic disjoint with respect to the neutral tones of the rest of the school.
- The colour also becomes the formal name written on a serigraphic plate next to the access, defining the individual spaces. We are in a different dimension from mere numerical denotation defining spatial and ordering (Faggioli, 2014).

Light. There are four sources of lighting, two natural and two artificial.

- Each room captures natural light through vertical windows that exploit the different angle of the roof; the geometry of these elevated windows is triangular and makes explicit the inclination of the roof.
- Another natural light is the indirect light coming from the corridor windows. The lighting enters the "Colour Spaces" precisely because there aren't any visual barriers
- Each room has a system with suspended neon tubes and anti-reflection lamellas.
- Two coloured sconces (applique) were added on the walls next to the entrances.

Connectivity. A very important element in the strategy that has guided the setting up of the "Colour Spaces" and that will direct its use. The building was covered by 95 WI FI Ubiquiti Network antennas able to manage up to 100 simultaneous connections.

The first design approaches and final results are shown in the following four images (Figures 1 to 4):



Figure 1. First project visualization. (Source: Sabatini & Virgilito, 2016).



Figure 2. Blue space. (Source: Preda, 2018).



Figure 3. Green space. (Source: Preda, 2018).



Figure 4. Red space. (Source: Preda, 2018).

The context and the method

The "Alessandro Manzoni" Civic Pole is based in Milan. The building houses some important schools run by the Milanese Municipal Administration: the "Alessandro Manzoni" High School, founded on 1861; the Istituto Tecnico Economico (ITE). The current site was designed in 1955 by the architect Arrigo Arrighetti and, along with relevant architectural qualities, it is inspired by traditional didactic principles that see teachers as guarantor of the school program and actors of a frontal and unidirectional transmission of knowledge. Everyone can learn everything, at the same time and in the same way, but the individuality of the student is not contemplated (Santoianni, 2010).

In defining the strategies that teachers use for their work, it has been useful to start from a critical reading of the traditional spatial structures prompted by the most recent Italian regulatory guidelines. The art. 1 of the Law n. 107/2015 defines the reasons and field of its existence by affirming "the central role of the school in the knowledge society [also as] a permanent laboratory for research, experimentation and didactic innovation". The 2013 "Guidelines on school building" by the Ministry of University and Research already called for a radical rethinking of the educational environments stating that "for a long time the classroom was the only place of school education […]. According to some teachers, schools are causing an "anesthetizing effect" (all identical, quite sad, with dull or casual colours, and classrooms maybe unchanged for decades) so as to define them "not places" ... " (MIUR, 2013, I.1, p .1).

Alternatively it was thought that teaching should be organized around the principle of a continuous composition and decomposition of plastic educational micro-contexts, that during a session could represent the leitmotif of an active and emotionally involving cultural exchange.

The Colour Spaces respond first to this logic. Adapting to changes in learning spaces implies changes in the general organizational context at school community level, but above all, a propensity to individual change. This last aspect calls for a personal willingness, often not easily achievable, to discuss one's own relationship with the transmission of knowledge, and even one's own "postural" and proximate approach to the living space.

If the platform, the chair and a frontal organization of the relationship with the students disappear, it changes something more radical than a simple didactic method: it changes the way of living and representing oneself in the social space and the way of leading (and no longer directing) a working group. It changes the vision of school: teaching and learning are a model that have not only a didactical impact on the student, but also a relational one, a set of shared social meanings (Zuccoli, 2017). In our case, the context had changed quite favourably to the experience we intended to conduct. In the school year 2012/13 the civic secondary school "A. Manzoni", hosted in the Civico Polo Manzoni, and previously called PACLE (Perito Aziendale e Corrispondente in Lingue Estere), was transformed in the "Istituto Tecnico Economico (ITE), branch "Amministrazione, Finanza e Marketing - Relazioni Internazionali".

The transition has involved a major investment in the redesign of the teaching curriculum and teaching methods. In particular, much has been done towards digitizing the teaching supports with the substantial elimination of paper books in favour of tablets lent to each student. The lessons have enhanced moments of active collaboration among students and between students and teachers, thanks also to the widespread use of Cloud Storage. Furthermore, in the document drawn up in 2016 by the teachers of the schools hosted in the building, they have questioned what should change to implement educational innovation. These are some answers: "we have to change the programs, the times of the lesson; in order to work in groups the spaces must be used differently […], taking advantage of corners, the gym entrance hall, the wide hallways, already occupied

spontaneously by the students, providing them with simple round tables and cabinets with writable surfaces; organizing multifunctional spaces; activating an "artistic" restructuring project of two rooms in the so-called "Margherita" space in the school's atrium, also for teachers' meetings ". (AA.VV., 2016, p. 31).

The organization of school spaces still coincides with a very common idea of correspondence between classroom and class of students, number of chairs and desks, the equivalent of a pedagogical thought based on frontal and one-sided transmission in the perspective of a type of behaviourist didactic with the teacher at the centre. All this needs to be radically addressed, making the perimeters of the classrooms flexible, introducing technology, reviewing lesson times, training teachers towards a vision that exceeds the purely functional and technical aspect of the classroom space. This approach has led to a change that requires a rethinking of the teacher's educational action: the educational space is always a designed space, where both an educating relationship and empathic sharing develop (Attia, Weyland, Bellenzier, & Prey, 2018). Hence, some places of teaching have changed to renew the didactic and innovate the school. We are therefore talking about spaces that favour "the adoption of didactic approaches based on active and experiential learning, aimed also at developing transversal skills and attitudes: collaboration, communication, critical thinking, problem solving, autonomy, flexibility" (Bottino, 2017).

Colour spaces are a concrete example of environments with the potential of being effective even if this will have to be verified on the basis of long-term analytical monitoring and observations. Already in the first decades of the 1900's Maria Montessori theorized that true educational innovation consisted in changing the environment. The environment is the place where the student grows, knows and relates, because the mobile and interconnected spaces encourage collaboration (Montessori, 1935, p. 45). In fact, all the elements contained in "Colour Spaces" can be moved, changed, washed. Furniture becomes the object of "doing", of actions, and it favours personalization, work in small groups that are composed and decomposed according to necessity: the furniture changes and adapts to the needs of different but contemporary activities. Pure colour also has its value. In their research on the implications for optimizing learning spaces, Peter Barret and Yufan Zhang of the University of Salford state that in an educational context colour is not just an aesthetic but a functional element with direct influence on behaviour (Barret & Zhang, 2009).

Conclusions

The effect expected from this experience is an increased number of students who perceive the school as a comfortable place: regardless of any consideration on learning styles and didactic planning, we believe that this is an important objective to counteract dispersion phenomena, to reduce part of the discomfort connected to adolescence and to increase the effectiveness of the educational experience. An idea strongly oriented towards the new didactics in transition from a transmissive dimension to active learning runs alongside. The same idea promotes spaces that while facilitating the learning process, are also shaped by it. This is all framed within a dialectical relationship where it is not always easy to determine "who generates what".

The proposed experiment is emblematic of an approach with greatest impact in terms of immediacy and diffusive potential compared to the construction of new schools.

Naturally we believe that both the renewal of existing spaces and the construction of new educational buildings must be supported. Our Administration has invested resources and thoughts on new schools, and in a few years, eleven buildings - some of which are already in progress - will be rebuilt from scratch or completely renovated. In many cases the design results are truly remarkable, from the architectural point of view and the

potential methods of use but we are aware that the replacement of a significant part of the school building heritage require decades of projects and huge financial investments. Educational innovation cannot wait so long. On the methodological level, the challenge of the experience is also this.

Realizing the "Colour Spaces", we wanted to demonstrate that change in the conditions of use of the environments, in the daily practice of the school:

- is possible to implement with relatively modest resources
- represents a significant pedagogical opportunity
- has a very strong relationship with the development of new educational experiences centred on the empowerment, participation and well-being of the students.

The theme of replicability was therefore immediately present (through comparison and "adaptive" dissemination methods). In particular this practice has taken two complementary but conceptually indivisible directions in our work: transforming what exists and pre-figuring what is useful.

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Reimagining educator preparation from the community to the classroom

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Abstract

This presentation highlights three teams from Arizona State University, Mary Lou Fulton Teachers College: Teacher Preparation Division, Educator Workforce Initiatives Team, and Community Design Team. This includes progressive and innovative work with local school districts to re-invigorate the teaching profession utilizing new differentiated roles and new designs in teacher preparation. Moving from the one teacher one classroom model to a team of educators with distributed expertise in open and collaborative spaces will not only impact student outcomes, but also educator job satisfaction and retention. Team teaching allows educators more significant opportunity to evaluate the impact on student learning, collaborate with peers, create opportunities to increase dialogue to check for understanding, and build relationships built on trust in a safe environment so that all students can improve. Additional tenets include working with community organizations, school districts, parents, students and local stakeholders to create inclusive cultures in the school and the community.

Keywords

TEAM TEACHING | EDUCATOR PREPARATION | COMMUNITY DESIGN | EDUCATOR WORKFORCE | RELATIONSHIPS | COMMUNITY CULTURE

Introduction

These action research studies focus on reimagining the way to train and deploy teachers into the workforce. Notably, these projects are looking at new ways to address the educator shortage by looking at innovative methods and strategies to increase educator training so that when they enter the workforce, they can be better prepared and experience greater job satisfaction. Additionally, they will stay in the workforce longer which will help increase student outcomes and increase community perceptions of educators. Though there is literature on team development and the impact of school leaders' influence on educator job satisfaction, there is no significant data on the small team leaders' influence on team members' job satisfaction. Theories like Maslow's Hierarchy of Needs (1970) and Bandura's self-efficacy research (1977) provide a foundational understanding of educators' needs and theories like servant leadership and social development theory are used to explore the characteristics and behaviors of the team leaders.

Local Context

Locally, in Arizona, at the beginning of the 2017 - 2018 school year, there were over 1,300 teacher vacancies and less than 50% of those vacancies were filled by people with a standard teacher certificate (ASU Morrison Institute, 2017). Shockingly, over 500 teachers abandoned or resigned their teaching positions between July 1, 2017, and September 30, 2017, leaving classrooms full of students with no certified teacher, forcing school districts to fill those vacancies with a revolving door of daily substitutes, long-term substitutes,

or emergency certified teachers. Over 566 of the positions were filled by districts offering what is commonly referred to as "6/5s contracts" where a current teacher gives up their prep period to teach an extra period per day (ASPAA, 2017).

While there is no current data on the impact of those "solutions"; it is safe to say that these unconventional options do impact the entire educational community including staff and community morale and the long-term educational growth of students. The revolving door of people in the classrooms affects student achievement. As of December 8, 2017, 3,400 individuals were working in Arizona classrooms, and they did not have the minimum requirements necessary to be considered the teacher of record by the state of Arizona. The teacher shortage crisis has caused additional stress from increased class sizes in situations where classes were collapsed, and the loss of a teacher prep period for planning and preparing for students. The loss of that small window of time is additionally significant as it removes the window to collaborate with peers or even to have a few minutes of mindfulness for the teacher. Additionally, it is the appropriately certified and highly qualified teachers that are being asked to "monitor" the classes with the substitutes or develop lesson plans to be shared, or continuously mentor the new teacher(s) next door.

National Context

Attracting and retaining high-quality teachers is critical to student success. "Research shows that teacher subject-matter knowledge is greatly associated with student learning. In this era of high standards and high expectations, having a highly qualified teacher has never been more important" (USDOE, 2009). Addressing the student achievement gap is a constant struggle because of the revolving door of substitute teachers, emergency certified teachers and newly certified teachers, school district mentors and coaches can not address teacher quality with the constant rebuilding and introduction of new teaching staff, it just takes time to master the art of teaching. Research indicates that the level of student learning was also affected by the experience level of the teacher, suggesting that the lesser the experience, the smaller the level of student academic growth (Kukla-Acevedo, 2009; Watkins, 2003).

Some stakeholders say the teaching profession has a shortage of available teachers, while others say the teaching profession is suffering from an exodus problem. Research shows up to half of all new teachers leave the profession within the first five years of teaching in the United States (Fisher, 2011; Ingersoll, 2012).

Commonly reported reasons given by teachers for leaving the profession are low salaries, working conditions, class size, workload, non-teaching duties, paperwork, lack of supplies and lack of support from school leaders (Riggs, 2013). A common belief is that those teachers who have administrative support tend to have more satisfactory working conditions. (Marlow, 1996). It is the idea of the influence of leaders on teacher job satisfaction, specifically, at a small team level that motivates us to continue to look into teams of educators and the leadership styles of those leaders.

The revolving door effect is not just noticed at the grade level or school site level. The community in and around the school feels the weight of the turnover of teachers. Parents are apprehensive about schools with significant turnover (Walsh, Ed, & Battitori, 2011). Not only do parents want to be able to connect with the teacher, but they also want the teacher to be able to connect with their child, and the idea of that extra caring adult in the school is critical. The community surrounding a school is also concerned about the inability to connect with staff that come and go each year causing the community to lose connection with the schools as well. (Olson-Stewart, 2015).

Pilot Projects

The Mary Lou Fulton Teachers College (MLFTC) at Arizona State University is currently involved in an ambitious mission to completely reimagine how a college of education functions, both internally as a preparer of future educators and externally as part of the system creating new pipelines into the education workforce. The belief is a college of education should play a unique role in bringing people and communities to the table to design new systems that ultimately improve student outcomes while bringing back the passion to education by increasing educator job satisfaction. Based on the idea that student outcomes improve with quality teachers and teacher effectiveness, the impetus to reimagine the one teacher - one classroom model where the single teacher is expected to be the expert in all subject areas, to create instead a team of educators with distributed expertise where the requirements are shared among the team. With this new model, each educator can focus on his or her passions and share that passion with the students. Understanding that every "wicked problem" (Jordan, Kleinsasser, & Roe, 2014) can be considered to be a symptom of another problem, Mary Lou Fulton Teachers College has dedicated multiple teams of professionals to address the issue from as many angles as possible including teacher preparation, community design, and educator workforce.

Working with local school districts to re-invigorate the teaching profession by developing new differentiated roles and unique designs in teacher preparation is a key priority. At the Mary Lou Fulton Teachers College (MLFTC) at ASU, we believe that it is time to reconsider the one-teacher-one-classroom model and start thinking about teams of educators with distributed expertise, working in concert to better meet the personalized, academic, and social-emotional needs of P-12 students and the communities in which they live. We believe that this reimagined team of educators will prepare our students for both the current and future workforce, and improve their prospects for gainful and meaningful employment.

Moving from the one teacher one classroom model to a team of educators with distributed expertise in open and collaborative spaces will not only impact student outcomes, it also impacts educator job satisfaction and educator retention. Team teaching allows educators more significant opportunity to evaluate the impact on student learning, collaborate with peers, create opportunities to increase dialogue to check for understanding and build relationships built on trust in a safe environment so that all students can improve (Mackey, O'Reilly, Jansen & Fletcher, 2018). Additional tenants include working with community organizations, school districts, parents, students and local stakeholders to take the opportunity to establish a positive growth culture not just in the school but including the needs and dynamics of the community.

These communities are rich with untapped resources of experienced adults who can contribute meaningfully to schools, but who currently do not have obvious ways to participate in the education workforce. For example, many businesses have programs to incentivize community service among their employees. Could we more systematically and strategically leverage these people to fill roles of real-world project supervisors? Alternatively, could higher education institutions and local school districts forge partnerships enabling undergraduate STEM majors to fulfill work study commitments in local secondary schools instead of the campus dining hall? Moreover, as the data suggest, many former K-12 educators may return to the classroom if it didn't require a full-time, five-day-a-week, 180-day commitment. They could fill any number of roles, ranging from small-group reading teachers to playground supervisors. The good news is that the educator talent pool today includes young millennials and post-millennials, demographics that tend to desire work environments characterized by qualities that education is not generally perceived as providing. They want flexibility and the freedom to think and act creatively as individuals and in teams.

In this new model, certified and professional teachers become even more crucial as they play the roles of specialists and team managers, ensuring that the team of adults is helping students meet their goals. Class sizes may increase though student-to-adult ratios would decrease. Salary savings in full-time employee or substitute

expenses could be used to improve the salaries of those educators taking on specialized roles and coordination. In this way, more students schoolwide benefit from the honed skills of accomplished educators, rather than only those 30 students in the single-teacher classroom.

Currently, our relationships with school districts, community organizations and stakeholders are helping us identify new roles for the education workforce to help create a positive impact on student success, increase teacher retention and increase the size of the educator workforce by building new pipelines into education to increase the number of caring adults interacting with our students. These new pipelines not only improve the pool of educators in the workforce and create more opportunities for students from all backgrounds the chance to make a connection with a caring adult that they might have missed in the traditional one teacher one classroom model. The creation of these new roles also allows for the opportunity to differentiate the education workforce so educators could focus on subjects they love and affords educators the opportunity to put more time into evaluating their impact on student learning.

Methodological details

Survey and interview methods are going to be used to collect quantitative and qualitative data from lead teachers, teacher candidates, principals, and community members. Interviews are being developed in a semi-structured format to enable the conversation to explore critical aspects of the participants' experience of leading or implementing team teaching.

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A creative collaboration to design innovative learning spaces

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Abstract

Our master's degree thesis is part of the renewal project of a twentieth-century secondary school, carried out by our architecture department and a research group in education science. We asked for feedback from students and teachers through a survey, so as to identify their problems and wishes and plan the improvement strategies accordingly. The survey was completed by 60% of the students (257 out of 427) and 22% of the teachers (12 out of 53). We then discussed the results of the survey with the teachers and decided to hand out a second survey to the students, which was more focused on the problems identified by the first one. On the basis of the data collected, we chose to begin by redesigning the hallways. We are currently working on multiple design proposals that we are going to submit to the teachers. Our goal is to demonstrate that a creative, participatory approach is a good way to introduce and encourage new usage habits. We hope that an overhaul of the space outside the classroom might give momentum to a wider innovation process of the building.

Keywords

SCHOOL DESIGN | PARTICIPATORY PLANNING | SPACE RECONFIGURATION

Introduction: A creative collaboration

A creative collaboration between different stakeholders is necessary to design comfortable school environments. The dialogue should be between designers, educational researchers and the school communities. In particular, it is important to listen to the students' voice (Cook-Sather, 2006). As Cook-Sather (2006) argued, "The most promising reform strategies involve[d] treating students as capable persons, capitalizing on their knowledge and interests, and involving them in determining goals and learning methods" (Cook-Sather, 2006, p. 3). In order to improve the design of a school's spaces, it is important to listen to these voices too. In this paper, we present an ongoing participatory process (Figure 1) involving the users of the lower secondary school "Ciresola", a facility of the early 21st century situated in Milano. This work is aimed at developing new interior design solutions to satisfy the needs of the school users.

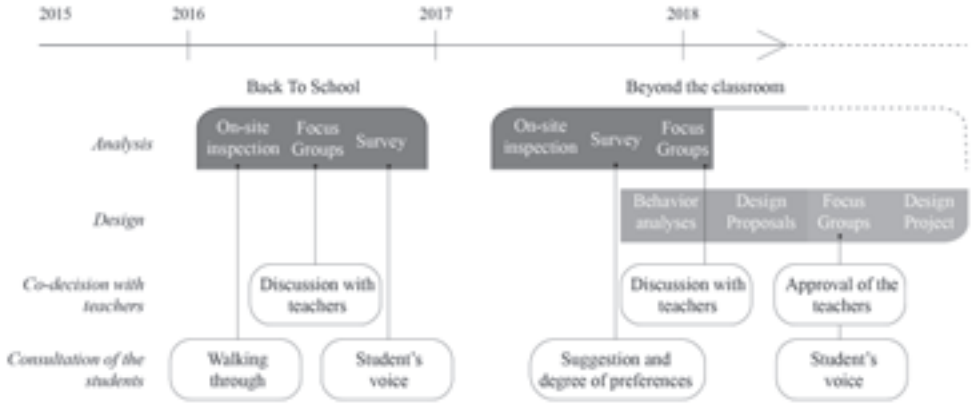

Figure 1. Diagram of the participatory program's process. (Source: Raimondi, 2017).

From "Back To School" to "Beyond The Classroom"

This work is based on the outcomes of the research program "Back To School" (Fianchini, 2017), developed by the research group Ambiente Scuola from the Department of Architecture and Urban Studies of Politecnico di Milano and the Department of Humans Sciences for Education of University of Milano-Bicocca. The aim of the program was to understand the problems and needs of the school's users through Post Occupancy Evaluation (POE). The research group conducted analyses through on-site inspections, focus groups and a survey, according to the "International Pilot Study on the evaluation of quality in educational spaces (EQES)" (OECD-CELE, 2009). The analyses were done on five secondary schools in Milano. In this paper, we are going to focus on the Ciresola Secondary School, which is one of the five schools studied in the "Back To School" program.

More in-depth analysis: the beginning of the design

Our thesis work started with the interpretation of the results of the survey of the "Back To School" program. The most interesting themes that emerged from these analyses are: the possibility to open the school spaces after school hours; the students' desire to increase the use of the courtyard; the thermal, luminous and auditory discomfort experienced by the students; the need for more room in the classrooms – which are compressed and disorganized –; the anonymity of the indoor spaces, which caused a sense of disorientation, and the lack of security for personal items.

These issues became the basis of a more specific survey, which was prepared in order to make the ideas and the desires of the students clearer. The students were asked to sort by priority the issues already expressed.

In the case of the Ciresola Secondary School the surveys were completed by 257 students out of 427 and 12 teachers out of 53 (Figure 2-3); dedicated fields were present for additional suggestions. The survey comprised questions about different themes: how the students reach the school and its accessibility; the usage of the different schools' spaces such as the hall, the hallways, and the courtyard; the opening of the building or the garden after school hours; the state of the indoor spaces; the classroom's functionality and comfort and the sense of security experienced by the students inside the school. As a consequence of the involvement in the "Back To School" research, the principal of the Ciresola School asked the research group to continue this work and to support them in the development of a renewal path of the school spaces.

In February 2017, we were involved in this research group to analyse the results of the previous survey and to develop a new survey called "Beyond the classroom, evaluation program of the spaces of the secondary School

Ciresola". This work has become our thesis project, which aims to support the participatory process in the Ciresola School, consisting of further focused analysis and a proposal of design solutions. These activities are connected to each other and so they have been carried out in parallel.

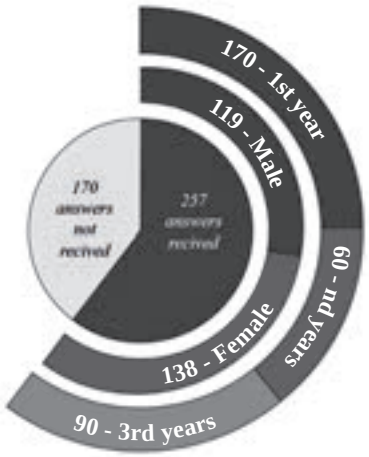

Figure 2. Students involved in the survey "Back To School". (Source: Raimondi, 2017).

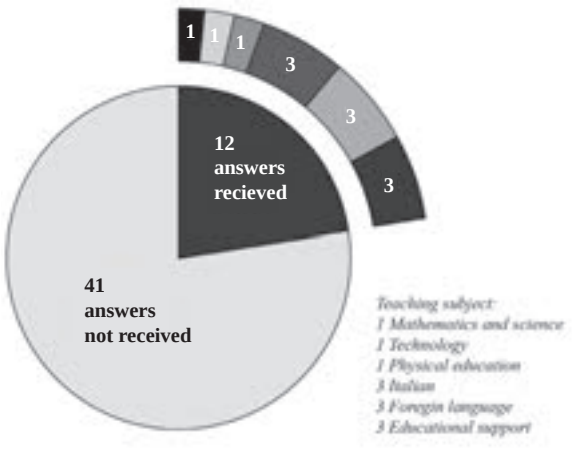

Figure 3. Teachers involved in the survey "Back To School". (Source: Raimondi, 2017).

Survey and focus groups

This second electronic survey "Beyond the classroom" was completed by 20% of the students: 88 out of 427 (Figure 4). In order to deal with the anonymity of the indoor spaces, the students' suggestions were to add some decorations on the school's walls, to design an indoor orientation system in the school and to add new functions to the hall and the hallways, like reading corners, meeting points and playrooms. Other needs were also expressed, like the desire to be able to use the courtyard – both for learning and for other activities, even after school hours – and the need for a secure place to leave students' personal objects (Figure 5).

The results of this second survey were presented to a group of teachers (Figure 6). On this occasion, the teachers underlined the necessity to intervene in the spaces outside the classroom that are empty and not in use. In order to encourage the dialogue, different case studies were presented. Several ideas emerged, such as the possibility to take some learning activities into the courtyard, to open the school to the community and to increase the flexibility of the common areas in order to use them for different purposes, like individual studying, team projects, reading corners, and so on. Some teachers suggested that a new space design could provide an opportunity to renew the teaching methods as well. After the discussion group, we decided to focus on the spaces outside the classrooms and to defer the reflection involving the classrooms to a later date.



Figure 4. Students involved in the survey "Beyond the classroom". (Source: Raimondi, 2017).

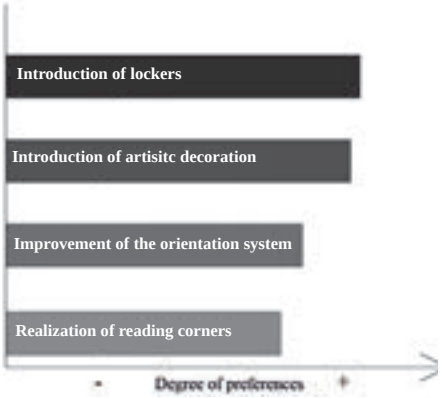

Figure 5. Preferences degree of the suggestion. (Source: Raimondi, 2017).



Figure 6. Focus group with teachers. (Source: Tomasoni, 2018).

On-site inspections

For our study, analysis of the school building – through on-site inspections – is essential. The school is a five-story masonry building, consisting of an empty basement floor; a ground floor shared between the kindergarten, the first-grade school and the secondary school; the first floor, where the elementary classrooms are located; and the second and third floors, which are used only by the middle school (Figure 7).

The first on-site inspection was carried out in the classrooms, while the following were done in the hall, in the hallways and in the common spaces. In regard to the classrooms, it was noticed that there are different comfort conditions. Some of them are exposed to a highly trafficked street and the noise makes it impossible to open the windows; others have problems caused by sun exposure. Moreover, they are configured in a traditional setting, characterized by poor flexibility. Following the teachers' suggestions, more in-depth analyses were done in the spaces outside the classrooms. We analysed their physical aspect and the students' usage patterns—through a behaviour analysis.

The physical elements that we considered were the dimensions and the shape of the spaces, the obstacles, the fixtures and the equipment in them. The study showed that these spaces are large and underused, and so they may be considered as opportunities to make something new. We also noticed the presence of some rooms which are very rarely used, such as the library and the art, science and music classrooms.

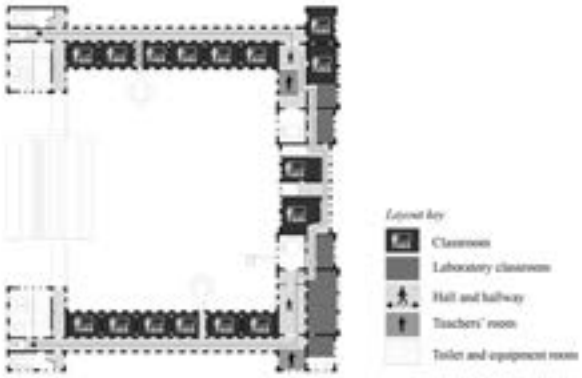

Figure 7. Planimetry of the second floor. (Source: Raimondi, 2017).

Behaviour analysis

The break times are the only three periods in which the spaces outside the classrooms are used. We observed that during the first and second break time, which are 10 minutes long each, students were only allowed indoors. They could use the classroom, the halls and the hallways near their classroom. During these two break times, the spaces outside the classrooms became meeting points. The only piece of furniture in these spaces is a single table with a few chairs. However, most of the time, they were not used, and the students prefered to gather around the windows or to stay in the space near the staircase (Figures 8-9). The third break occurs after lunch only on Mondays and Wednesdays. It is thirty minutes long and the choice to use the courtyard or the indoor spaces is made by the teacher.



Figure 8. Indoor break-time in the hall: students staying near the stairs. (Source: Tomasoni , 2018).



Figure 9. Indoor break-time in the hallways: students staying in the window's niche. (Source: Tomasoni , 2018).



Figure 10. Outdoor breaktime: students sitting on steps and on the ground. (Source: Tomasoni , 2018).



Figure 11. "Outdoor breaktime: students playing and sitting on the bench". (Source: Tomasoni , 2018).

The courtyard is characterized by the presence of a basketball court, a garden with trees, two benches and some tables without chairs. The students are not allowed to use balls; some of them play tag, while others stay sitting on the benches, the tables and the stairs (Figures 10-11). After these analyses, we can affirm that the students prefer informal places where they can experience more freedom

An ongoing project

Our thesis is an ongoing work, which will be characterised by the collection of design examples, the development of design proposals and the discussion of them with the school users. At this moment, the school is characterized by a traditional teaching method, but the principal is evaluating the possibility to modify it. This change is not seen in a positive way by all the school users; therefore, the firsts design proposals are focused on the spaces outside the classrooms and their aim is to show that a transition is possible. After that, we will develop a new-layout proposal which will also consider the classrooms.

The design proposals will be developed from the students' suggestions as well as the results of our on-site analyses. For example, the courtyard, which we see as an opportunity, is large and shady and so, if furnished, it may become a space for outdoor lessons, or it may be opened after school hours. The library – which is now ignored by the students – may be developed into some reading corners, placed near the classrooms and accessible during break times. The halls are empty and not used; therefore, we are going to propose flexible setting with informal sitting places as carpet and soft seats (Figure 12). The corridors are characterized by more space than necessary, so we plan to furnish them with lockers and to add seats in the niches near the windows (Figure 13).

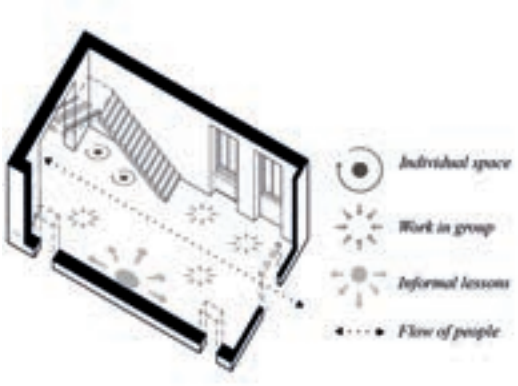

Figure 12. Introduction of a flexible setting in the halls. (Source: Tomasoni , 2018).



Figure 13. Upgrading of the corridor space. (Source: Tomasoni , 2018).

We would also like to propose a layout solution, in which we plan to realize a laboratory centre on the third floor and to furnish the smaller rooms with flexible furniture. These proposals will be configured in a more specific way and then discussed and screened with the teachers; finally, they will be presented to the students.

Conclusions

It is known that the characteristics of physical spaces influence how they are experienced (Lee, 1978; Oblinger, 2006; Strange and Banning, 2002). Therefore, it is possible to affirm that the configuration of the learning environments is able to influence the teaching methods (Monahan, 2002).

Thanks to the participatory process adopted – which is divided between the co-decision activity, as focus groups, carried out with the teachers and the consultation activities, as a survey, done with the students (Górkiewicz, 2016) – we were able to identify the preferences and the degree of need for the different design proposals.

We can affirm that choosing a creative and participatory approach was the right process to re-think the school's spaces. This method of design takes a lot of time and sometimes is not approved by all (in our case, the students' involvement was discussed with the teachers) but we think that this collaborative approach is necessary for a higher probability of success: the students and the teachers should be able to influence the process in order to obtain spaces in which they are comfortable.

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Making sense of design thinking

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Abstract

In interdisciplinary research contexts, an increasing regard for 'design thinking' as an effective driver of 'innovation' continues to grow. However, in these contexts, how does Design Thinking interact with other research strategies and methods? Could a better understanding of design methods assist our appreciation of interdisciplinary research that engages Design Thinking? Research effort on the Innovative Learning and Teacher Change (ILETC) project (ARC 2016-2020), specifically identifies Design Thinking methods and how they have informed ILETC data gathering. Co-design workshops engaged the use of Design Thinking to direct teacher agency toward collaborative efforts in realising the potential of 'Innovative Learning Environments' (ILEs). This knowledge has assisted the scaffolding of complex research pathways through ILETC research, priming the central question of the project: how can teachers engage and activate their ILEs?

Keywords

DESIGN | DESIGN THINKING | INTERDISCIPLINARY | LEARNING

Co-designing teacher learning

The strategies of design thinking have become synonymous as shorthand for effective creative collaboration. Design expertise is increasingly recognised as an effective driver of innovation, tackling complex 'wicked problems'; the types of messy, aggressive, and confounding problems that are ill-defined in cause, character and solution (Rittel et al., 1979). In 2018, the Organisation for Economic Co-operation and Development (OECD) report: 'Teachers as Designers of Learning Environments' (Paniagua & Istance, 2018) notes that pedagogy needs to be combined with expertise in the design of learning environments in order for teachers to get the most out of ILEs. The report makes explicit the relationship that teachers could have with design:

> *"It is precisely through the idea of teachers as designers of learning that innovation at the level of practice can be seen as a normal side of the teaching profession to solve the daily challenges in a context which is in constant change"*
>
> - (Paniagua & Istance, 2018, p. 21)

The report goes on to state that there is a clear relationship between the role of design in schools that lends itself to teacher expertise;

> *"Teacher learning—collaborative, action-orientated, and co-designed—is fundamental to change."*
>
> - - (Paniagua & Istance, 2018, p. 43)

This suggests that alongside the capacity for active collaboration, the ability to 'co-design' is required if we're to enact change in learning environments. If the report is to be followed, and teachers are to strengthen their practice by designing, then we must look to the methods of design to appreciate how design can bring about this change. Design has given shape to the emergence of ILE's — how could the process of designing bring them to life?

This paper identifies the ILETC project as engaging design thinking strategies. Co-design workshops looked at how the use of Design Thinking can 'nudge' teachers toward more collaborative efforts in realising the potential of ILEs. This knowledge has assisted the scaffolding of complex research pathways through the ILETC research, priming the central question of the project: how can teachers engage and activate their ILEs?

In November of 2017 the ILETC 'Technical Report 2' (Mahat, Grocott & Imms, 2017) was released, outlining the outcomes of five 'Design Thinking' workshops held as part of the first phase of the ILETC project. Design thinking is cited as a fundamental approach to phase one of the ILETC project. The workshops were developed to capture a broad range of data, indicative of teachers' lived experiences in innovative learning spaces. The data capture was consistent with the style of design thinking workshops—using reflective and speculative activities and aiming to provide a reciprocally useful experience for participants. Significantly, the report states; "design thinking approaches required some modification to ensure that categorical data was collected from the sessions to allow for this analysis. Collecting participant responses via coloured post-it notes, photographs of assemblages, and short written response served this need" (Mahat et al., 2017 p. 16).

In order to comprehend this knowledge, and the role of design expertise more broadly, a clearer analysis of design methodologies, and the attendant epistemological underpinnings, could contribute to how we conceptualise design in interdisciplinary research contexts.

What exactly does it mean to 'co-design'?

Co-design is aligned with the design thinking movement. 'Design Thinking' as a concept remains an evolving construct (Martin, 2009). There are conflicting ideas of how to define Design Thinking. For the purposes of establishing a guiding conceptual construct, Design Thinking is "a discipline that uses the designer's sensibility and methods to match people's needs with what is technologically feasible" (Brown, 2008). However, what does it mean to do research where co-design is present? And is there a satisfactory theory of Design that could guide our understanding of Design Thinking?

Design is all encompassing, having an effect on nearly every aspect of life (Pahl, Beitz, Grote, & Feldhusen, 2007). In order to design well, designers have to draw on knowledge from diverse areas. Design is not just a knowledge intensive activity, it is also a purposeful, social and cognitive activity that is engaged in a dynamic context aimed at "changing existing circumstances into preferred ones" (Simon, 1969). Design then, has gradually come to be regarded as a topic of scientific research with its own distinct body of knowledge.

Designerly Epistemologies

Designers find and formulate problems within the broad context of the design brief (Cross, 2006). This is indicative of a reflective practice model articulated by Schön as 'problem setting'. According to Schön (1983) problem setting is the process in which, interactively, we name the things to which we will attend and frame the context in which we will attend to them. In other words, designers work in differing modes: selecting aspects of the problem space to which they direct their attention (naming) and then identify areas of the solution space

that they choose to explore (framing). In order to formulate a design problem to be solved, the designer must frame a problematic design situation: set its boundaries, select particular things and relations for attention, and impose on the situation a coherence that guides subsequent moves (Schön, 1983).

Designerly Ways of Knowing (Cross, 2006) also develops an epistemological frame for design. According to author Nigel Cross, our comprehension of traditional scientific ways of understanding are augmented through 'designerly ways of knowing'. In other words, design can be understood as an epistemology—and in an interdisciplinary context this is crucial to establishing the rigor of design research when traversing across different domains of knowledge (Jonas, 2007). Design research in the ILETC project presents an opportunity to look at design as a distinct way of knowing and finding out about how schools engage with innovative learning environments. Design has a peculiar way of knowing and for this to be knowable, Cross states:

> *Design must have its own inner coherence, in the ways that science and the humanities do, if it is to be established in comparable intellectual and educational terms. But the world of design has been badly served by its intellectual leaders, who have failed to develop their subject in its own terms.*
>
> - (Cross, 2006, p .6).

Having put forth his thesis, Cross examines these ill-defined 'ways of knowing' in design and begins to build a picture of a slowly growing field of enquiry in design research from which it is possible to begin to build some concepts and perhaps draw some conclusions. Cross notes that, there have been a small number of studies that set out to observe how the designer works. These studies support his view that there are distinct 'designerly' forms of activity that are separate form scientific and scholarly activities. The experiments provide a picture of the designer as having the capacity to synthesise during the problem-solving process, as opposed to scientists who usually problem solve by analysis. It points to an important feature of design activity which is a tendency to generate quick solutions, rather than fixing on a prolonged analysis of a problem. Like Jonas, Cross cites Simon's (1969) term 'satisficing' as opposed to optimising. That is, producing any one of what could well be becoming a variety of satisfactory solutions rather than overly focusing on one optimum solution. This is supported by other studies of design behaviour cited by Cross, engineers (Marples, 1961), urban designers (Levin, 1966) and architects (Eastman, 1970). This distinction is an indication or reflection of the nature of the design task and the types of problems designers tackle. Cross notes:

> *"The designer is constrained to produce a practicable result within a specific time limit, whereas the scientist and scholar are both able, and often required, to suspend their judgments and decisions until more is known — further research is needed is always a justifiable conclusion for them"*
>
> - (Cross, 2006, p .6).

It is now widely recognised that design problems are ill-defined, ill-structured, or 'wicked' (Rittel & Webber, 1973). This means they are not the same kind of problems that scientists, mathematicians and other scholars set themselves. Furthermore, they are not problems for which all the required information is necessarily at hand for the problem solver. In the initial stages of research on the ILETC project, one of the key aims was to establish existing teacher knowledge surrounding ILEs but also to reveal beliefs or attitudes that previous research attempts have not being able to ascertain. Designerly approaches through participatory design workshops have initially been successful in dealing with the 'fuzzy front end' of the project by allowing the ambiguity of this unknown to be worked through using tangible designerly approaches. If we are to deal with ill-defined 'wicked' problems, the designers must learn to have the self-confidence to define, redefine, or change the 'given' nature that problems present us with. Cross cites Jones (1970) who commented that, 'Changing the problem in order to

find a solution is the most challenging and difficult part of designing. Jones equally points out that, 'designing should not be confused with art, with science, or with mathematics'. This then presents us with the kind of warnings about failing to recognise the particular nature of design. Simon (1969) famously stated that: 'The natural sciences are concerned with how things are … Design, on the other hand, is concerned with how things ought to be.'

Methods, and Methodology in Design

J. Christopher Jones outlined the need for new methods in design in his seminal text 'Design Methods' (1980). He noted that the traditional methods of design had become tired, and that design required an expanded set of methods to cope with the complexity of the modern world. According to Jones (1980), we can infer that the directions in which a person will choose to transform a problem or a design, and the directions that might be ignored, will be closely related to opinions of morality and value.

> *"Thus, we can see that the human capacity to reduce complicated questions to simple ones is an expression, not only of a person's awareness of the external realities involved, but also of his or her idea of what is good and what is evil, what is beautiful and what is ugly, what is enjoyable and what is tedious."*
>
> - (Jones, 1980, p. 30)

Jones (1980) describes the traditional methods for dealing with the messiness of designing as a way of operating that deals with a singular conception of the whole and uses the example of the scaled drawing as a means of reducing the complexity of designing. In that, traditional design methods use a tentative solution as an immediate means of exploring both the situation that the design is to fit and the relationships between the components of the design.

In this model of designing, we see an expansion of design 'problem solving' as one that goes beyond the 'components' or 'product' level to include both systems and community concerns. In this expanded model of designing, the community becomes an overarching tier for designers to encounter when considering their consultative responsibilities. Many of the issues we face in modern society are the result of designed outcomes. Jones suggests that perhaps this is because Design has been disembodied from the community in which it is designing for. And perhaps the remedy is to bring the community back into the process of designing. The language wasn't fully formed when Jones was theorising back in 1980, but he is suggesting we need to engage with co-design methods to fully realise the potential of designing.

The workshops employed methods now synonymous with 'design thinking' approaches. These approaches involved generative, collaborative activities which aimed to explore the central assumptions stated by the ILETC. According to the official report, Design Thinking is generally used to refer to creative exercises for 'seeing' new future possibilities. According to Meinel & Leifer (2011) Design Thinking involves a process that is human-centred, works with ambiguity and makes ideas tangible. Thus, Design Thinking workshops engage stakeholders directly, working through ambiguity albeit using tangible materials. The flow of Design Thinking workshops moves from ambiguous, divergent thinking to more convergent solution-oriented modes of cognition. Ultimately, design thinking in this context offered an opportunity to co-create with the teaching community and in turn form a much richer understanding of the research landscape (Meinel & Leifer, 2011). The report continues by stating that; 'synthesising post-it notes under emotional responses might facilitate how

the teachers come together to talk, tell, and explain their experiences" (Mahat et al., 2017, p. 14). The question remains as to how we derive meaning from this synthesis of data and how Design Thinking reveals a plethora of data that can be bewildering to interpret.

Conclusion

This paper has examined the emergence of design thinking as an epistemological approach to interdisciplinary research. Design methods can evolve alongside other research methodologies, situating design as augmenting the meaning we derive from research in areas of investigation across trans-domains of knowing. In order to move toward this expansion in the research landscape, designers need to better articulate the nature of their sense-making expertise.

Designers are 'ill-behaved' problem solvers—that is, they don't spend much time or attention on defining the problem (Cross, 2011). Nigel Cross suggests that the over-concentration on problem definition does not necessarily lead to successful design outcomes—that successful design has more to do with effective 'problem scoping' and on a focused approach to gathering problem information and prioritising criteria. Setting and changing goals is an inherent element of designing (ibid.). Good designing also requires the effective generation of alternatives, de-mystifying the creative thinking associated with good design with more concrete language like 'problem framing', 'co-evolution' and 'conceptual bridging' between problem space and solution space seems to be a better approach to describing what actually happens in creative design. Perhaps design as 'co-evolution' provides a prompt for looking at design processes when articulating methodologies in transdisciplinary contexts. Design research must articulate the conceptual foci of its contribution in order to transmit ideas through methodologies unfamiliar with designing.

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Presenter Biographies

Arnaldo Arnaldi

NORMALEARCHITETTURA, Italy.

Arnaldo Arnaldi. Architect at NORMALEARCHITETTURA°. He graduated with honors in Architecture at Politecnico di Milano, as well as studying at ETSAS-Sevilla (Spain) and ETSAM-Madrid (Spain) He took part in several architectural, urban and landascape design workshops, including "Matosinhos Sul" at FAUP Porto (Portugal), and "Architectural and urban design in chinese context", at Tonji Univeristy, Shanghai. He has been working both as a professional and with a number of architecture firms and has designed several pieces of furniture for a number of Italian furniture companies. Since 2011, he has been working in design for schools through the format collabora(c)tive design, a process of participatory design, as a prerequisite for the design of learning environments. From 2009 to 2014 he has been professor in "Architectural Design" and since 2010 he is thesis supervisor at Politecnico di Milano. He is professor of interior design at Politecnico di Milano and NABa Nuova Accademia di Belle Arti a Milano.

Julia Atkin

Learning by Design, Australia.

Julia Atkin is an independent education and learning consultant who works across education settings in Australia and internationally. She has a passion for learning and understanding how we learn. Julia's initial research involved developing an understanding of the thinking processes involved in deep learning and in helping learners learn how to learn. For over 30 years Julia has worked with teachers, school leaders, designers and architects across early childhood to tertiary settings to transform all facets of education from the industrial era to the knowledge era and the learning demands of the 21st century. She has been recognised as an Apple Distinguished Educator Award; a fellow of theAustralian College of Educators, the Sir Harold Wyndham Medal, one of The Bulletin'sAustralia's Smart 100 and awards for the design of educational facilities in collaboration with Mary Featherston, Hayball and Gray Puksand.

Patrícia Baeta

University of Lisbon, Portugal.

Patrícia Baeta is a doctoral student in education- technology enhanced learning and societal challenges at the Institute of Education at the University of Lisbon, and has a master's degree in education and digital technologies. She is a member of the research project "Technology enhanced learning at Future Teacher Education Project" (teL@FTE-Lab) at the Institute of Education of the University of Lisbon.

Niamh Barry

School of Education, University of Limerick, Ireland.

Niamh is a structured PhD candidate in education at the University of Limerick, Ireland. She is supervised by Dr John O'Reilly and Dr. Keelin Leahy, has a BSc Physical Education and Biology from Dublin City Unviersity and a MEd (learning space design) from University College Dublin. Niamh also works as a secondary school teacher in the areas of Junior Science, Senior Biology and Physical Education.

Evert Binnard

Science, Engineering and Technology Group,
Faculty of Science,
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Evert Binnard, bachelor in social work, master in cultural studies and certified high school teacher in humanities, has a great affinity with education. He is the project researcher of ALINA (Active Learning classrooms IN the KU Leuven Association, OOF2014/43), a Flanders-wide project that aims to bridge the gap between active learning methods and next generation classrooms.

Joanne Blannin

The University of Melbourne, Australia.

Dr Joanne Blannin has taught in four countries, in three languages and has developed an in-depth understanding of learning and teaching. Her many education roles have included outdoor education curriculum director, language tutor, bilingual teacher, curriculum leader, leading teacher, teacher trainer, Victorian Department of Education project officer, lecturer, and school leadership coach. Having taught in both the private and public sectors, Joanne now presents internationally on effective digital pedagogies & change leadership. Joanne is currently the Digital Learning Leader at Graduate School of Education (MGSE) at the University of Melbourne.

Bodil Bøjer

Institute of Architecture and Design, The Royal Danish Academy of Fine Arts Schools of Architecture, Design and Conservation and Rune Fjord Studio, Copenhagen, Denmark.

Bodil Bøjer is an industrial PhD candidate, based in the design agency Rune Fjord Studio and enrolled at The Royal Danish Academy of Fine Arts. Her research examines the relationship between learning space design and pedagogical practices in primary and secondary schools by using a research through design approach in several cases and design experiments. The aim is to create new knowledge about participatory building design and the potential use of design as a tool to support learning. Bodil holds a MA in Art History and Aesthetics and Culture and has 10 years of practical experience working with spatial design. Giuseppina Cannella, Stefania Chipa, Samuele Borri, Lorenza Orlandini

Samuele Borri

Indire (National Institute for Documentation, Innovation and Educational Research), Italy.

Samuele Borri. Engineer and manager of the Indire IT Area, Samuele is responsible for Indire research area "School Architecture", which is focused on the analysis of the relationship among spaces (in terms of functionality, comfort and wellbeing so as learning practises could be effective). He is also responsible for the research area of learning times (matching the students' needs) and the change of learning environments under the impact of the introduction of technologies into daily classroom activities.

Chris Bradbeer

The University of Melbourne, Australia.

Chris Bradbeer is an Associate Principal at Stonefields School in Auckland where he is engaged in teacher professional learning, leadership and collaborating with students, staff and design professionals in conceptualising the 3rd stage of building development. He is currently completing a PhD focusing on the enactment of collaborative teacher practices in Innovative Learning Environments in New Zealand primary schools, with a particular interest in potential theoretical and professional adaptation for teachers. Chris is also a Research Fellow (part time) on The University of Melbourne's Innovative Learning Environments & Teacher Change Project.

Marco Braga

Graduate Program of Science, Technology an Education, CEFET/RJ, Brazil.

Marco Braga is PhD (Production Engineering) and heads the graduate program of Science, technology, and education at the Federal Center for Education and Technology-Rio de Janeiro (CEFET/RJ) in Brazil. He leads the N@MELAB, a lab for developing research about knowledge management in innovative spaces.

Giuseppina Cannella

Indire (National Institute for Documentation, Innovation and Educational Research), Italy.

Giuseppina Cannella. Since 2003 she has been working for Indire (www.indire.it) as instructional designer and researcher. She was in charge of the project "Classi 2.0" whose main aim is to create ICT enriched settings and innovative methodologies for the everyday classroom activities, that was the focus of her PhD in Pedagogy. Lately her research activities focus on two main topics: the small rural schools and the challenges to overcome isolation and the relation between Pedagogy and Space whose findings were reported in the Indire website (http://www.indire.it/progetto/architetture-scolastiche/).

Raffaella Carro

Indire (National Institute for Documentation, Innovation and Educational Research), Italy

Raffaella Carro. Researcher at Indire where she has been working since 1998. Formerly involved in managing training actions and on research activities dealing with the use of ICT in the didactics, she is now focusing on how school physical environments support the changing of pedagogical practices.

Joann Cattlin

The University of Melbourne, Australia

Joann Cattlin is the Project Manager for the ILETC project. Her role is to coordinate project activities, information management, engagement with partners and stakeholders, social media, staffing, event management and finances. Joann has worked in universities for the last 15 years as a researcher, project manager and librarian. Joann has co-authored a number of articles, book chapter, project reports, conference papers and websites. She is an experienced reference librarian with a Masters of Information Management (RMIT) and undertakes practice based research in research engagement and knowledge mobilisation. In 2019 she was awarded the Universitas 21/University of Melbourne Professional Staff Scholarship to travel to USA and Canada to investigate university support for knowledge translation.

Hui Soo Chae

Columbia University, U.S.A.

Hui Soo Chae is Senior Director of Research, Development, and Strategy for the EdLab and the Gottesman Libraries at Teachers College Columbia University.

Mario Chiasson

Université de Moncton, Canada.

Mario Chiasson (ABD) is currently enrolled in a PhD program at Université de Moncton, NB, Canada. His research focuses on the design of spaces that influence the learning and teaching process that enable the development of 21st century competencies such as computational thinking. Over the years, Mario has helped countless organizations and institutions (schools, districts, ministries, colleges, universities) in implementing action plans to transform instructional practices. He is a leader in technology innovation at Anglophone East School District in Moncton, New Brunswick, Canada. In 2004, Mario completed a Master's degree in ICT in school administration. Mario is also a Microsoft Innovative Educator, a Cisco IT Essential Teacher, an Apple Teacher as well as an Apple Distinguished Educator (ADE). He has been a part of many provincial projects including a 1-to-1 laptop project, Learning Commons, provincial and district collaborative platforms, as well as international collaborative projects.

Stefania Chipa

Indire (National Institute for Documentation, Innovation and Educational Research), Italy.

Stefania Chipa. PhD in Educational Sciences with a program focused on the use of ICT in learning environments, has been a researcher at Indire since July 2014. Her research focus is the relationships among teaching strategies, educational settings and curriculum organization. These themes are investigated under the perspective of a school conceived as learning community, in strong relation with the territory. She is member of Indire research teams on "School Architecture" and "Small Schools"; she works with "Avanguardie Educative" (Educational Avant-garde) to implement the Service Learning pedagogical approach as a possibility for the schools to expand the learning environment to the community space.

Chiara Filios

NORMALEARCHITETTURA, Italy.

Chiara Filios. Architect at NORMALEARCHITETTURA°. She graduated in Architecture at Politecnico di Milano. She studied architecture at ETSAV Valencia (Spain) and ETSAB Barcelona (Spain). She took part in several architectural, urban and landscape design workshops, including "Architectural and urban design in chinese context", at Tonji Univeristy, Shanghai. She has been working in the architecture field both as a professional and with a number of architecture firms in Spain, Italy and United States ranging from architectural design to its contruction phase, but also interior and furniture design. Since 2011 she has been working in design for schools through the format collabora(c)tive design, a process of participatory design, as a prerequisite for the design of learning environments. She has taught design studios as an assistent professor at Politecnico di Milano and guest critic at CUNY-Department of Architecture, New York. She is professor in "Interior Design" at NABA- Nuova Accademia di Belle Arti in Milano.

Raechel French

The Unversity of Melbourne, Australia.

Raechel has spent the past 6 years as an educational planner at an architecture firm in Austin, Texas helping plan and design schools across the United States. She earned a B.E.D. in Architecture and a B.S. in Psychology from Texas A&M University and a Master's in Human-Environment Relations from Cornell University, focusing on Facility Planning and Management with a minor in Organizational Behavior. In Feb 2017 Raechel French joined the team as a Fulbright Postgraduate Scholar from the US and following this commenced a PhD with the project. Raechel's goal is to help expand the role of school architects and planners so that they have more influence on the use of the buildings they design. Raechel finds that the design process as it is, while engaging and collaborative, often only includes a small subset of the eventual users. This is especially troublesome when a school system hopes to deviate from the traditional models of teaching and learning and relies upon the building itself to create the shift. Raechel sees a new paradigm in which there is a strategic organizational alignment process integrated within design work to help school clients holistically realize their vision.

Mie Guldbæk Brøns

LOOP.bz, Denmark.

Mie Guldbaek Broens works as a consultant in innovative learning environments. The past eight years she has been studying physical spaces and social behaviour, mainly in educational environments. With an M.Ed in Educational Anthropology, she does in depth research on teachers' collaboration and the interdependency with physical space. Her observations often take place in innovative learning environments that have an emphasis on 21st Century learning. She studies schools on a more general level by visiting schools all over the world looking at the connection between spaces and pedagogical approaches.

Gustavo Guttmann

Graduate Program of Science, Technology an Education, CEFET/RJ, Brazil.

Gustavo Guttmann is a doctoral student in the graduate program of Science, technology and education (CEFET/RJ) and works in the Undergraduate School for Teachers Training in the same institution at Friburgo City (Rio de Janeiro). He is member of N@MELAB.

Philip Idle

EIW Architects and Association for Learning Environments, Australia.

Philip is an architect with over 30 years experience in the briefing, planning, design and delivery of education projects in Australia, and more recently in Tanzania and China. His work encompasses both the private and government sectors in Australia and has extended to service work in Tanzania and the International School sector in China. With expertise in the design and planning of educational facilities, Philip leads the consultation phases of projects that has led to him developing great empathy for learners and teachers resulting in designing contemporary and innovative learning environments. An original Australasian member of the Association for Learning Environments (formerly CEFPI), Philip will take up the position of Chair of the International Board in November, 2018. Philip has encouraged the leadership to develop a more comprehensive way of viewing cultural and geographic differences as potential opportunities for sharing knowledge and developing quality learning environments for learners and teachers alike.

Wesley Imms

The University of Melbourne, Australia.

Wesley Imms is an Associate Professor in the Melbourne Graduate School of Education, is that Schools Head of Visual Art Education, and its Research Higher Degree Coordinator for Curriculum and Teaching. He is the lead Chief Investigator of the ARC Linkage Project Innovative Learning Environments and Teacher Change which will run from 2016-2019, and also led the Evaluating 21st Century Learning Environments ARC Linkage Project (2013-2017). He has been involved in a range of solo and collaborative projects since 2000 involving approximately $11 million of external funding, has published over 70 peer reviewed articles, chapters, conference papers and books, numerous reports and invited lectures here and overseas. He is an experienced educator and is involved teaching subjects spanning visual art curriculum and studio practice, innovative learning spaces, and Masters-level learning spaces capstone and teacher/practitioner subjects, in addition to supervising 19 Doctoral, Master of Education/Philosophy and Master of Teaching honours

Anne Knock

The University of Melbourne, Australia.

Anne Knock is a PhD candidate in the ILETC project at the University of Melbourne. Anne's research within the project focuses on adapting teacher mindframes and pedagogy in order to take advantage of the affordances of innovative learning environments for student deep learning. Her career in education commenced as a primary school teacher in Sydney, teaching for 17 years in several schools.

Since leaving face-to-face teaching, Anne has held several roles in education and administration. Since 2010 she has worked as an educational consultant, facilitating workshops, writing and speaking on the future of learning and learning environments.

Ching-Fu Lan

Columbia University, U.S.A.

Ching-Fu Lan is a researcher at EdLab, Columbia University. His research interests include creative technologies and learning experiences in innovative learning spaces.

Jackie Lightfoot

Studio 93 Limited, U.K.

Research-led furniture designer Dr Jackie Lightfoot has focussed on school furniture for over a decade. Her PhD at the University of Brighton and funded by the Arts and Humanities Research Council investigated the socio-cultural and design factors affecting children's seated posture in primary schools. She has designed an innovative primary school seat, with and for young children to support their natural good posture and healthy inclination to move. This is currently being user-trialled in UK classrooms. Her design company, Studio 93 Limited, aspires to transform children's education through participatory-research-led furniture design and the practical application of good ergonomics.

Marian Mahat

The University of Melbourne, Australia

Marian Mahat is the lead Research Fellow of the ILETC project. As the Research Manager, she oversees all research activities and the dissemination of project findings including the management of Research Fellows and project PhD students. Marian has more than twenty years of professional and academic experience, spanning several Australian universities, the Australian Federal and local governments, the LH Martin Institute for Tertiary Leadership and Management, the Melbourne Centre for the Study of Higher Education (MCSHE), as well as the private sector. Highly proficient in both quantitative and qualitative research methods, she has worked on collaborative projects, written numerous publications and presented in conferences in higher education.

Mariagrazia Marcarini

University of Bergamo, Italy.

Mariagrazia Marcarini. PhD in Human Capital Formation and Labour Relations, she is currently a teaching assistant of special education at University of Bergamo and educator in secondary school CIA (Centro di Istruzione per l'Adulto e l'Adolescente) at Polo Alessandro Manzoni of Council of Milan. She is responsible for the Strategic Area "School Architecture" of the ADi (Associazione Docenti e Dirigenti scolastici italiani). Mariagrazia has over twenty-five years experience in special education as an educator and teacher of mathematics for students with disabilities and as coordinator of vocational training courses for students with disabilities of Council of Milan. Currently she collaborates with architects Chiara Filios & Arnaldo Arnaldi (NORMALEARCHITETTURA) to redesign learning environments for helping teachers change their learning practices through collaborative design with students, teachers and parents. She published the book "Pedarchitettura. Linee storiche ed esempi attuali in Italia e in Europa, Studium, Roma 2016" and other contributions about learning environments.

Áine Moran

Le Chéile Secondary School, Ireland.

Dr Áine Moran completed her undergraduate honours degree in Commerce at NUI Galway and holds master's and PhD degrees from the Education Department at Dublin City University. She also holds post-graduate diplomas from University of Limerick, St. Angela's College Sligo and NUI Maynooth. She has worked in several schools throughout Ireland teaching Business Studies, Economics, Business, Accounting and Religious Education. She has held the positions of chaplain in a DEIS school (School Designated as having a socially disadvantaged student population by the Irish Department of Education and Skills), Deputy Principal in an amalgamating Community School and is currently the Principal of a newly established Catholic secondary school in Dublin 15. She gives occasional lectures at University College Cork and is a part time lecturer and research supervisor at the School of Education of Hibernia College. She has presented her research both nationally and internationally, most recently as a visiting fellow at Notre Dame University, Indiana.

Sara Mori

Indire (National Institute for Documentation, Innovation and Educational Research), Italy.

Sara Mori, cognitive-behavioral psychotherapist with a PhD in Evaluation of Educational Process and Systems, is a psychologist at Indire. She has been working since 2011 on the effect of change and innovation on educational improvement.

Robert Morse

Arizona State University, U.S.A.

Robert Morse is the Executive Director of Professional Experiences at Arizona State University's Mary Lou Fulton Teachers College. His responsibilities include the placement of student teacher candidates, management of all syllabi and handbooks related to the internship and student teaching experience, hiring, and training of student teaching supervisors, and supervising the program specialists who support iTeachAZ Site Coordinators. Prior to serving in his current role, Robert was a program specialist for the iTeachAZ teacher preparation program. In this role, he provided coaching and program support to site coordinators and served as an iTeachAZ Site Coordinator in the Madison School District for three years. Robert holds a B.S. Degree in Global Business/Marketing from Arizona State University a Master of Education Degree in Curriculum and Instruction, with a focus on English as a Second Language, and a Master of Education Degree in Educational Leadership from Arizona State University

Elena Mosa

Indire (National Institute for Documentation, Innovation and Educational Research), Italy.

Elena Mosa. Researcher at Indire where she has worked for 13 years dealing with educational research. She started as an instructional designer, and is now working in the wider topic area of school innovation from an organizational and methodological point of view. Among her research interest is the topic of new (physical) learning environments.

George Nantwi

Columbia University, U.S.A.

George Nantwi is a researcher and product manager at EdLab, Columbia University. His research interests include youth and emerging technologies, online identities, and self-directed learning.

Gary Natriello

Columbia University, U.S.A.

Gary Natriello is the Ruth L. Gottesman Professor in Educational Research and Professor of Sociology and Education in the Department of Human Development at Teachers College, Columbia University.

Lorenza Orlandini

Indire (National Institute for Documentation, Innovation and Educational Research), Italy.

Lorenza Orlandini, PhD. She has been a researcher at Indire Since July 2014. Her main research areas are the relationship among school and community (through Service Learning pedagogical approach), the organization of school time and the relationship between pedagogy, learning space and learning practices. She is member of Indire research teams on "School Architecture" and "Avanguardie Educative" (Educational Avant-garde); she works with "Small Schools" to implement the Service Learning pedagogical approach in Italian schools.

Mark Osborne

The University of Melbourne, Australia.

Mark is a director of an educational consultancy in New Zealand, and has been a teacher, school leader and consultant for more than 20 years. He works nationally and internationally in future-focused education, innovative learning environments and educational leadership. As a practitioner researcher, Mark is in a unique position to research the process of implementing an innovative learning environment from the perspective of those undertaking it. Being a member of a community of school leaders implementing significant change means he can employ qualitative, subjective methods in order to capture and analyse the experiences of this community, employing auto-ethnicity to do so.

Erin O'Reilly

University of Montana, U.S.A.

Erin O'Reilly is a doctoral candidate and Adjunct professor in Teaching & Learning at the University of Montana with a focus on professional development for technology integration. Erin is an innovative, flexible, and organized educational professional with both K-12 and higher education teaching experience.

Silvia Panzavolta

Indire (National Institute for Documentation, Innovation and Educational Research), Italy.

Silvia Panzavolta, psychologist, psychotherapist and language mediator. is a researcher at Indire, where she has been working since 1998. Silvia deals with educational documentation and knowledge sharing. At present she is researching the different angles of school innovation

Neuza Pedro

University of Lisbon, Portugal.

Neuza Pedro has a PhD in ICT Education and is a professor in education and teacher training at the Institute of Education-University of Lisbon. She coordinates the E-learning lab of the University of Lisbon as well as the masters degree program in Digital Technologies and Education of the Institute of Education.

Iris Peeters

Faculty of Science & Leuven Engineering and Science Education Center (LESEC), Belgium.

Iris Peeters is the promotor of the ALINA project. Her main goal is quality assurance through professionalization of teaching staff and the development of educational strategies. She conducts research in active learning, curriculum design and incoming students guidance.

Anna Peterson

Queen's University, Canada.

Anna Peterson is an early career researcher and elementary school teacher interested in developing a common language through which educators and architects can refine the relationship between innovations in teaching, learning, and design. With the support of the Social Sciences and Humanities Research Council (SSHRC) Joseph-Armand Bombardier Canada Graduate Scholarship, Anna completed her PhD in Education at Queen's University, Canada. Her international, interdisciplinary research contributes an educational and humanistic perspective to the study of school architecture and is featured in the Fall 2018 American Institute of Architects – Committee on Architecture for Education – Research Task Force publication Learning by Design: DIALOGUES.

Cecilia Raimondi

Politecnico di Milano, Italy.

Cecelia was an Erasmus student at Uppsala University in 2014 where she completed an internship with the Departement of Art History, were she studied building typologies in Visby. In 2016, she earned her bachelor's degree in Environmental Architecture at Politecnico di Milano. Her thesis explored the influence of space in human relationships. Now Cecilia is working with Sara Tomasoni on her master's thesis under the supervision of prof. Maria Fianchini. Their thesis starts from the research "Back to School", done by a group of scholars in architecture and design from Politecnico di Milano and in educational science form University of Milano Bicocca. The thesis's subject is the renovation of a school and its aim is to support in the process of improvement of school spaces.

Nick Salmon

Collaborative Learning Network, U.S.A.

Nick Salmon of the Collaborative Learning Network is a ninth-generation educator focused on educational facility planning, professional development of teachers and design support for future-flexible learning environments. Recent experiences include: Montana Conference of Educational Leadership, Association For Learning Environments, SXSWEDU, Ohio School Facilities Commission, University of Montana, Montana State University, and Harvard University Learning Environments For Tomorrow Institute.

Patrizia Sandri

University of Bologna, Italy.

Associate professor in Teaching and Special Pedagogy of the Department of Educational Sciences "G.M. Bertin" of the University of Bologna (Italy), with suitability of Chair professor. Director of the study and research Centre for Disability, Education and Inclusion (CEDEI) of the Department of Educational Sciences. Patrizia carries out training and research activities in Italy and international contexts. Her research activity, documented in numerous books and articles, focuses on the analysis of educational and didactic methodology to ensure the inclusion of all people, including those who have a serious impairment, and on the special teaching of mathematics and conventional time systems.

Assunta Sassone

Department of Education, Municipality of Milan, Italy.

Assunta Sassone has a master's degree in Physical Education and is a qualified teacher for middle and secondary schools where she has taught for 15 years. On January 2018 she graduated in Management of School and Educational Institutions from the Politecnico of Milan. Since 1998 she has been working at the Education Department of the Municipality of Milan. Currently she is Chief of Staff at the Education Department and also looks after their special projects.

Cristiano Scevola

Department of Education, Municipality of Milan, Italy.

Cristiano Scevola obtained a master's degree in Architecture (Hons) from Politecnico of Milan and collaborated with the institution as a subject matter expert. He has been a teacher for 25 years in middle and high schools. Since 2006, he has been working as the leader of the School Network Office at the Education Department of the Municipality of Milan. On January 2018 he graduated in Management of School and Educational Institutions from the Politecnico of Milano.

Ben Scragg

Arizona State University, U.S.A.

Ben Scragg envisions and plans school and community design lab partnerships that support creative problem-solving and innovation in Arizona's K12 schools. As the Project Manager and Lead Design Strategist in the Office of Scholarship & Innovation at Arizona State University's Mary Lou Fulton Teachers College, Ben partners with schools to engage in open-ended design thinking and methodology to generate solutions to the unique challenges and opportunities schools face in 21st century American life. A veteran educator with Chicago Public Schools, Ben has an MA in Philosophy of Education and an MBA from The Ohio State University.

Michael Stewart

Arizona State University, U.S.A.

Michael Stewart is the Director of Educator Workforce Initiatives in the Mary Lou Fulton Teachers College where he is currently part of a team working on moving from the one-teacher-one-classroom model to teams of educators with distributed expertise, working with open collaborative spaces to meet the personalized, academic, and social-emotional needs of Pk-12 students. Michael has a diverse employment background from his work teaching high school social studies in the South Bend School Corporation, Site Manager with the Office of Michigan Works Welfare to Work Program to Police Sergeant with the City of Surprise. Michael also holds B.S. Sociology from The University of Notre Dame and a master's in Counseling and Human Services from Indiana University. Michael is currently working on his Doctoral degree at Arizona State University where his research study focuses on identifying the leadership styles of non-traditional leaders on small teams and their influence on job satisfaction.

Sara Tomasoni

Politecnico di Milano, Italy.

In 2016 Sara earned a bachelor's degree in environmental architecture at Politecnico di Milano. Her thesis was about the redevelopment of a farm into a co-housing environment. Because of her interest in historical buildings and in the possibility of giving them new life, she decided to study architecture and heritage conservation. Sara is now working on her master's degree under the supervision of prof. Maria Fianchini. The thesis's subject, *the renovation of a school*, originated from Sara's internship, in which she analyzed the results of the survey for the "Back to School" program - research conducted by a group of scholars in architecture and design from Politecnico di Milano and from Educational Science from University of Milano Bicocca. The thesis's aim is to support in the process of the improvement of the school spaces.

Dion Tuckwell

Monash University, Australia.

Dion's research interests derive from a transdisciplinary reappraisal of design practice. His research studies the role and agency of design as it intervenes in systemic social problems. Dion maintains a communication design studio practice with clients in both the private and public sector. His studio work and current research outputs explore how design practice collaborates with the science of learning. He has a Master's Degree from the University of Melbourne Graduate School of Education and is currently pursuing doctoral studies in Design at Monash University.

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Author/s:
Imms, W; Mahat, M

Title:
Transitions 2018: Continuing the conversation

Date:
2019

Citation:
Imms, W; Mahat, M, Transitions 2018: Continuing the conversation, Proceedings of international symposia for graduate and early career researchers in Australasia, Europe and North America, 2019, pp. 1 - 231

Persistent Link:
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