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The Rhetoric of Multi-Display Learning Spaces: exploratory experiences in visual art disciplines

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Abstract

Multi-Display Learning Spaces (MD-LS) comprise technologies to allow the viewing of multiple simultaneous visual materials, modes of learning which encourage critical reflection upon these materials, and spatial configurations which afford interaction between learners and the materials in orchestrated ways. In this paper we provide an argument for the benefits of Multi-Display Learning Spaces in supporting complex, disciplinary reasoning within learning, focussing upon our experiences within postgraduate visual arts education. The importance of considering the affordances of the physical environment within education has been acknowledged by the recent attention given to Learning Spaces, yet within visual art disciplines the perception of visual material within a given space has long been seen as a key methodological consideration with implications for the identity of the discipline itself. We analyse the methodological, technological and spatial affordances of MD-LS to support learning, and discuss comparative viewing as a disciplinary method to structure visual analysis within the space which benefits from the simultaneous display of multiple partitions of visual evidence. We offer an analysis of the role of the teacher in authoring and orchestration and conclude by proposing a more general structure for what we term 'multiple perspective learning', in which the presentation of multiple pieces of visual evidence creates the conditions for complex argumentation within Higher Education.

Keywords: learning spaces, multi-display systems, comparative viewing

Introduction

The fundamental purpose of this paper is to argue that Multi-Display Learning Spaces (MD-LS) can support interactions between teachers and learners during small group activity in innovative and useful ways. We open a discussion whose purpose is to understand the use of multi-display systems for learning from a Learning Spaces perspective and we clarify what we mean by

such a perspective early in the paper. We continue by contending that MD-LS, such as the example shown in Figure 1, can support the construction of complex, argumentational and disciplinary analysis based upon an ecology of the interactions between technology, space and pedagogy. Though our paper is not an empirical report, we do briefly sketch practical experiences of using an MD-LS space within a postgraduate Classics module in order to illustrate our ecological view more concretely.

Currently, much learning and teaching is conducted using presentation software based around the paradigm of "a single, static slide projected onto one display screen, changing sequentially over time" (Lanir et al., 2008a, p.695), such as PowerPoint. Although there is some evidence of the popularity of such systems with students (Austin-Wells et al., 2003; Susskind, 2005), a body of opinion has developed which criticises the ways in which such sequential presentation systems mediate the communication which occurs within learning. Sequences of thoughts become isolated onto slides (Myers, 2000), the linearity of the presentation renders it difficult for the speaker to respond to the unexpected (Adams, 2006), concepts are reduced to banal bullet points, placed into unneeded hierarchies and separated from analysis (Tufte, 2003), and the use of prescripts such as slide templates encourages authors to modify their thoughts to fit the mode of presentation, rather than vice versa (Fagerjord, 2005).

Figure 1: A Multi-Display Learning Space at the University of Nottingham

Suggestions to address these issues can be clustered into the rhetorical and the technical. Rhetorical solutions proceed from the basis that it is the poor *usage* of presentation systems such as PowerPoint that are at fault, rather than the systems themselves (Schwom & Keller, 2003). By raising their awareness of media *rhetoracy*, presenters can use sequential presentation systems in a more focussed and deliberate way, as one component within a rhetorical toolkit rather than an instinctive mechanism (or even crutch) to disguise a poorly constructed presentation (Kjeldsen, 2006). Technical solutions, by contrast, focus on the development of new presentation systems which aim to overcome the aforementioned limitations through mechanisms such as using multiple simultaneous displays. Examples include the *Polyvision Thunder, Smart*

Meeting Pro and *Multi-Slides* systems under investigation at the University of Nottingham (Bligh, 2009), as well as the *MultiPresenter* system (Lanir et al., 2008b), which is designed to enable spontaneous and non-linear presentation styles, easy revisiting of earlier information, and creative use of multiple information spaces, and to harness the cognitive benefits associated with large presentation spaces to facilitate dialogic communication.

In this paper, we combine these approaches and broach the question: what are the rhetorical affordances of these newly emerging, multi-display systems for interactive small group learning? Or to put it another way, do these systems enable and support innovative configurations of media-based teaching? Such a question requires a holistic analysis which reaches beyond human-computer interaction. We must understand the learning context within which the system is to play a role, together with the Learning Space which encapsulates the systems, teachers and learners.

Acknowledging that, like other social and collaborative activities, learning is *situated* within its environment (Suchman, 1987), in recent years the Learning Spaces research agenda has sought to focus on the role within the learning process played by the contextual space, through an explicitly interdisciplinary approach which links pedagogical theories with the built environment. More broadly and ambitiously, this increased focus upon Learning Spaces provides an opportunity to link the design of physical learning environments to an understanding of cognitive theories, a development process for technological innovations and the construction of teaching methodologies, all co-ordinated around a common aim of facilitating more effective models of student learning. Within this paper we begin an ecological analysis of MD-LS scenarios based upon a three-tier structure. In terms of *learning technology*, we describe **Multi-Display Systems** as a group of technical systems allowing for the visual display of multiple pieces of visual information in an appropriately partitioned way which vary in their modes of information, control and interaction. In terms of *learning spaces* we describe **Multi-Display Learning Spaces** as configurations of learners, tutors, technology, environmental variables such as light and sound, furniture and boundaries, which differ in terms of their affordances for vision, listening, interacting and movement but have in common the provision of multiple surfaces to display information. Although the MD-LS we describe here contains a Multi-Display System, some MD-LS may be configurations of multiple independent display surfaces within a space (for example, an informal learning area surrounded by digital signage). In terms of *learning methodology* we describe **Multiple Perspective Learning** as a form of real-time, co-located multimodal argumentation which must be located within disciplinary epistemology and notions of evidence, and which takes forms aligned with the affordances of space, technology and learning objectives. Learning is a process of meaning making which involves more than argumentation, subsuming inquiry, rote learning and other forms of construction, but nonetheless argumentation forms an important component of disciplinary communication (Habermas, 1984). Within this paper we use this lens to focus on how students within Higher Education can be supported in their formative attempts to communicate within their discipline, through a process which includes exemplary argumentation from a tutor in relation to visual stimuli together with a supportive structure for student response which corresponds well with the properties of technology and space.

We describe in brief our experiences of using an MD-LS space to support taught postgraduate Classics students in the module *Ancient Art and Its Interpreters*. Art History and related disciplines have long been concerned not merely with the visual impact of art, but also with the space in which it is viewed and the development of methodologies to support the construction of arguments based on the analysis of the viewer (Dilly, 1995; Nelson, 2000).

Thus the relationship between technology, space and disciplinary methodology is, in this case, genuinely dialogic in the sense of being interrelated and mutually interacting; while the Art Historical practice of *comparative viewing* (Dilly, 1995) which we detail later represents a learning methodology whose aims are aligned with the affordances of MD-LS, conversely contemporary MD-LS could be viewed as having their roots in the dual slide projection lectures given by art historians since the late 19th Century.

Within Art History and related disciplines, a crucial concern is the construction of analysis and narrative around pictures and other visual evidence (Grimm, 1892/1981). The methodological and technical mechanisms creating the conditions for such an analysis have developed in parallel over a period of two centuries (Dilly, 1995; Nelson, 2000), focussing upon the display and comparison of sets of visual evidence and the synchronisation of that evidence with verbal narrative within the comparative viewing process. This verbal narrative is *deictic*, based around the identity of the orator, requiring contextual information from supporting visual materials and utilising spatial and temporal relationships between argument and visual evidence. More specifically, comparative viewing involves the analysis of one piece of visual evidence *in terms of* another, enabling argumentation to be built around (deliberated) juxtaposition.

The initial purpose of this paper, then, is to link MD-LS scenarios with the requirements of comparative viewing, thus offering a good example of the methodology-technology-space relationship which forms the basis of our understanding of these scenarios. From the perspective of comparative viewing, MD-LS offer opportunities to allow tutors to manage and present larger amounts of evidence, for the purpose of constructing democratised in-session discourse based upon the wider range of presented perspectives, and they can reduce the technical skillset required to engineer such presentations. From the perspective of Learning Spaces, MD-LS presents a useful example of the unification of space and technological systems in that these wall-sized systems can define the boundaries of the space and dominate it visually, while comparative viewing provides a useful example of an organisational and task-based structure which can relate these elements to a process of learning — albeit in ways which are problematic due to its historical development as a method to allow art historical *experts* to structure their lectures in convincing ways.

Within the paper we begin by contextualising the work within the Learning Spaces research agenda, demonstrating the importance of linking learning space to learning technology and disciplinary methodology. We subsequently demonstrate how MD-LS scenarios offer one good example of how this link can work in practice and describe the spaces and the technologies within them with which we have experience. Next we outline the development of comparative viewing as a disciplinary methodology within Art History, and draw upon our practical experiences to analyse the alignment of affordances of methodology, technology and space within it. We conclude by generalising our scenario, contextualising comparative viewing as a disciplinary specialisation of argumentation within higher education, and present the case that MD-LS scenarios therefore represent a kind of Learning Space which can be used to scaffold complex argumentation within HE settings through the presentation of visual evidence in an orchestrated way. We use the term 'multiple perspective learning' to describe this process of learning through, in our example, visually-stimulated argumentation.

Learning Spaces

It has long been recognised that the way in which people conceive space is determined by their goals and intentions and that space itself *moulds* behaviour (Arnheim, 1977). But only recently have attempts been made to

problematise the ways in which space interacts with theories of learning, usually under the topic heading Learning Spaces. Definitions of the term Learning Space vary and are contested. From a perspective focussed on the environment itself, Monahan (2002) uses the term "built pedagogy" to describe the notion that appropriately designed architecture can serve as an embodiment of pedagogical principles; conversely Savin-Baden (2008) defines Learning Spaces as "places of transition, and sometimes transformation, where the individual experiences some kind of shift or re-orientation in their life world", and thus focuses upon the individual. Such differences in focus can be explained in terms of disciplinary variation, and parallel those within studies of cooperative work where a distinction between *space* (the location) and *place* (personal being and acting) has become established (Harrison and Tatar, 2008). Nonetheless, it is useful to note the kinds of relations between people, pedagogy and place which these foci imply, and the holistic conception of learning contexts required to operationalise those relations.

From a built environmental perspective, Van Note Chism (2008) identifies the common elements of what she terms "intentionally created spaces" and claims are harmonious with learning theory as: flexibility, comfort, sensory stimulation, technology support, and decentredness. From a psychological perspective, Graetz (2008) argues that successful learning environments must balance elements of coherence, complexity, legibility and mystery. From a pedagogical perspective, Savin-Baden (2008, p12) acknowledges that learning spaces fulfil a contextual purpose, which may be for example bounded, formal, social, silent, writing, dialogic or reflective. Thus, Learning Spaces as a specific focus for research can be viewed as a young field whose strength lies in the connections it makes between its progenitor fields of research and the opportunities it offers for collaboration between those of disparate disciplinary backgrounds.

Against this backdrop, and bearing in mind the large-scale investments in new Learning Spaces being made by many universities (JISC, 2006), it might seem reasonable to assume that the evaluation of these spaces in terms of their impact upon pedagogy and people would be underway in earnest. While evaluation and research clearly have different demands, interactional bases for such investigations can be derived from well-established literature. Gaver (1992), for example, documents an ecological approach to understanding media (video) spaces, which focusses upon their affordances in terms of vision, sound, movement and structure of interaction and which might reasonably be applied to physical Learning Spaces. Bielaczyc (2006) uses the term "social infrastructure" to relate the adoption of educational technology to factors including socio-technical space, as well as cultural beliefs, pedagogical practices and the relationship between the classroom and the outside world. More recently, notions of spatiality and space usage have emerged from a variety of disciplinary perspectives.

The reality, however, confounds these assumptions about evaluation. Pearshouse et al. (2009) conducted a study whose aim was to document the evaluation process for Learning Spaces at Higher Education institutions across the UK. Although the original intention was to uncover those evaluation processes used to assess learning within Learning Spaces, such innovative practices proved difficult to find and the project was forced to conclude that that the high level of funding and innovation present within the field of designing and creating learning spaces had not been replicated within evaluation processes (Bligh et al., 2009). Instead, with a few notable exceptions, documented evaluations of Learning Spaces were driven to investigate space usage *efficiency*, to justify investment, or to satisfy the requirements of the UK's National Student Survey, which explicitly focuses on student satisfaction rather than learning. Moreover, many of the staff involved in executing evaluation were keen to emphasise that their activities were "not

research", by which it seems they meant "not driven to investigate notions of learning seen as theoretical and difficult to measure".

Such findings need to be placed within context, especially with regard to the issues often raised when solving problems which do not easily sit within a disciplinary category. Collaboration between stakeholders can present problems within the field of educational technology. The relationship between technology and didactics has a troubled ideological history to begin with (Nordkvelle, 2004), which is further compounded by recent political contexts which have seen teachers' use of technology advocated and implemented largely by those outside the teaching profession and, furthermore, linked with increased workloads (Fisher, 2009). If the Learning Spaces field is seen as a superset of educational technology requiring even more interdisciplinary collaboration from different academic tribes (Becher & Trowler, 2001) as well as professionals, students and support staff — including educationalists, psychologists, computer scientists, architects and built environment researchers, auditory engineers, Estates professionals, artists and designers, evaluation experts, critical theorists, exponents of human geography, visual culture theorists, and more — then the obstacles to fruitful interdisciplinary collaboration are legion.

While the situation is not surprising, it is nonetheless disappointing, since the design of new learning spaces needs to be based upon appropriately analysed findings from previous designs. The transformative potential of appropriate feedback, for both students and teachers, has been widely recognised within the assessment of many academic programmes (Nicol & Macfarlane-Dick, 2006). Here, a similarly iterative process, perhaps taking a design research approach based upon embodied conjectures which can be assessed (Sandoval, 2004), offers a plausible way forward in relation to developing the new learning spaces, learning technologies and learning methodologies which we are contending are necessary.

Pearshouse et al. (2009) conclude by suggesting FELS, a Framework for the Evaluation of Learning Spaces, which provides a common vocabulary to facilitate discourse around evaluations and a structured checklist of issues to be considered by individual practitioners and evaluators. The aim is to allow for the comparison and meta-evaluation of evaluations, and to facilitate conversations between practitioners. However, and perhaps wisely, FELS does not attempt to prescribe a set of priorities for individual evaluations since these are likely to be heavily influenced by context.

Here, we propose Multi-Display Learning Spaces as an environment that can promote innovative forms of learning in a way that links elements of space, technological systems and pedagogical models. Furthermore, the paper acknowledges these are highly visual in nature, and uses this as the basis to select an appropriate evaluative framework based upon an ecological view of environmental affordances which are related to the discipline-specific mode of teaching.

Multi-Display Learning Spaces

At the most simple level of analysis, a Multi-Display Learning Space is an environment in which facilities are provided for the display of multiple pieces of information simultaneously. Although the MD-LS discussed here use computer-based display systems to achieve this effect, it is possible to see this scenario as a further development of established examples including lecture theatres with multiple sliding blackboards within Mathematics (Lanir et al., 2008a) or dual slide projectors used within visual art disciplines (Nelson, 2000). These examples, together with those we examine within this paper, are intended to support synchronous and co-present learning and are concerned with the physical space. We would like to retain a distinction between this

context and research into Media Spaces, which we take to involve distributed and sometimes asynchronous collaboration environments. We do acknowledge contexts where the two scenarios co-exist, such as in the iTLO (interactive Teaching and Learning Observatory, Coyle, 2004) where video conferencing technology is used to link physical spaces across distance.

A useful backdrop for considering MD-LS scenarios is the study of Large Displays from a human-computer interaction perspective (Czerwinski et al., 2006). Usually contextualised within corporate office settings, and driven by a motivation to investigate and enhance productivity effects upon workers, research into the use of multiple monitors demonstrates cognitive benefits such as improved recognition memory and peripheral awareness, as well as an increased ability to manage flows of information within virtual worlds (Tan et al., 2003). The use of multiple monitors to observe disparate pieces of information by experts was noted as a naturally occurring (or "indigenous") practice within work settings long before computers with multiple monitors became a common occurrence (Luff et al., 1992). More recently, HCI researchers have noted the popularity of the multiple monitor setup for desk work. Extrapolating this trend, and considering display space as a gradually increasing proportion of physical space, Czerwinski et al. (2006, p.70) ask: "How might users cope with and benefit from display devices that provide 25% to 35% of their physical desk area or perhaps one day cover entire office walls?".

Indeed, an early attempt to create a purpose-built environment to support group working using multiple displays was intended to support business decision-making processes. The Pod (Seward et al., 1993) is an important example since it was conceived as a *room* (space) rather than merely a technical system, and explicitly linked with notions of management decision-making (methodology). Consisting of a purpose-built room with a series of projected "information faces" surrounding a round table and accompanied by a technician's workstation, The Pod could display information including 35mm slides, video footage and TV camera feeds, controlled either by the technician or a participant, to feed into processes such as group planning, reviewing and design activities. Evaluation (ibid, pp.160-161) indicated that The Pod allowed a high throughput of information, successfully retaining that information's richness while reducing *variety* (complexity of information display) to a manageable state. The Pod was therefore seen both as a high performance human-computer interface and as a space which increased the focus of its participants through good design of lighting and boundary conditions and the removal of extraneous distractions. The Pod was claimed to raise group members to a higher level of performative consciousness: "middle managers thinking and acting like top managers, top managers thinking like the board" (ibid, p.160).

It is important to emphasise that corporate professionals are not Higher Education learners, and nor are group decision-making processes by such people automatically good analogies for processes of critical learning or Higher Education argumentation, but experiences with The Pod do provide a starting point in terms of considering the potential benefits of MD-LS scenarios — particularly because of the emphasis on *senior management*. Certainly, we would welcome environments which raised the level of thinking within student groups, but it is important to consider what such an improvement would mean within an HE group activity context.

Within an organisational setting, Seward et al. (1993, pp.154-156) define the interests of senior management as making judgements about the relevance, accuracy, validity and reliability of evidence, usually externally derived, at a high level of abstraction and without the benefit of complete information. These processes seem similar to those demanded of students, and are

analogous to those of argumentation, for example the "complex, partially structured, open" domains for which abductive argumentation can be useful within case-based collaborative learning (Dowell & Asgari-Targhi, 2008, p.231). While this paper leaves most cognitive considerations for future study, the notion that the high throughput of visual evidence within the environment can be linked to this performance, perhaps through a process of cognitive offloading onto the technology (Dror & Harnad, 2008) is encouraging. On the other hand, the notion that The Pod is a high performance *normalizer* (Seward et al., 1993, p.159) which enables groups to arrive at decisions is problematic since the development of critical thinking within Higher Education is not synonymous with the gaining of group consensus. On the contrary, the transformations the individual undergoes at University desirably involve processes which are reflective, challenging, disjunctive and liminal (Savin-Baden, 2008, pp.70-74) rather than consensual, and might plausibly benefit from an inability to reach consensus as well argued but contradictory cases fail to be easily resolved. Such an understanding therefore necessitates a different *balance* of learning space, technology and methodology than that which might be directly derived from The Pod, because while the presentation and understanding of evidence is common to the two scenarios, the judgement processes which sit on top of these are not. How much change (if at all) must occur within each of the components of technology, methodology and space is, however, unlikely to be simple to determine except by gradual accretion of experience.

Other examples of multi-display systems exist, but few have been developed for education and fewer linked with notions of spatiality. A recent example of a multi-display system is MultiPresenter (Lanir et al., 2008b), a presentation system aimed for use within lecture theatres equipped with two display screens. MultiPresenter aims to support innovative content delivery by lecturers by providing specialised systems for the authoring and live presentation of information. The system for live presentation supports presentation flow by using both scheduled, managed transitions and the impromptu ability to embed chosen sections of content upon the secondary screen so that they persist through the rest of the teaching session (Lanir et al., 2008b, p.519). Two distinctions can instantly be seen between the focus for MultiPresenter and the MD-LS scenarios being discussed here. Firstly, MultiPresenter is a piece of learning technology rather than a learning space. Of course, MultiPresenter sits within an MD-LS, but the spatial structure of the lecture theatre itself is regarded as a given by the project developers, and determinedly so since the easy integration of the system into existing lecture theatres, which already have multiple projection screen infrastructure in place, is regarded as a crucial enabler for the project. Secondly, the learning scenario which the technology is intended to support is the mass lecture, rather than small group collaborative working.

Our interest in MD-LS scenarios derives from our experiences in using Multi-Display Systems to support collaborative small group learning in a variety of Higher Education settings. In 2006, the Visual Learning Lab at the University of Nottingham purchased two PolyVision Thunder systems (Milligan, 2008). Thunder, a multi-display system consisting of a central "easel" designed to look like a paper flipchart (Bligh & Li, 2009), features digital versions of pens, erasers and other input devices and a series of projected screens designed to visually mimic the effect of flipchart pages being hung along a wall (Figure 2). This system was installed to support small group collaboration within two spaces: a small seminar room and an open access library setting. What quickly became apparent were the differences between the two installations. While the small seminar room successfully supported, in quick succession, a variety of collaborative activity by students within academic disciplines such as Built Environment, History and Education (Bligh, 2009), the utilisation of the

system within the library setting was slow to develop and often problematic in practice.

Oldenburg (1999) has emphasised the importance within community building of "third places" distinct from home (first) and work (second) places. Oldenburg's thesis is that contemporary society actively seeks out places such as cafes, coffee shops, bars and community centres to serve as anchors within a community (ibid) which provide crucial venues for the serendipitous meetings and social interactions from which communities thrive (and which are also, it is worth noting, crucial to notions of informal learning). Though a detailed comparison of venues requires another paper, the realisation that the physical space bounded by the technology interacted in different ways with the identity of the social place was instrumental in developing our understanding of the importance of spatial identity in the use of multi-display systems. The reports of Thunder which have appeared in the literature concurrent with our use of the system (Gilbert, 2008; Hopkin et al., 2008) are technology-focussed, but all document installations within second places. While we wish to report on a system other than Thunder, we continue that trend here and must be content with merely indicating the importance of studying MD-LS within other contexts in the future.

Figure 2: PolyVision Thunder within (a) a seminar room and (b) an open access library setting at the University of Nottingham

More recently, we have begun to work with two other Multi-Display Systems (Bligh, 2009). The first, Smart Meeting Pro, features multiple interactive whiteboards working within the same teaching session, and offers the possibility of direct physical interaction with each of the display surfaces; this contrasts with the Thunder systems, where the projected screens could be manipulated only via the easel. The second system, Multi-Slides, has been developed as a plug-in for Microsoft PowerPoint which adds the ability to display the presentation over multiple projectors. A version of Multi-Slides is distributed along with a book on business meeting methods (Peberdy & Hammersley, 2009); like Thunder and Smart Meeting Pro, therefore, the system can be understood as a business tool being adopted into educational use. These two systems co-exist with one of the Thunder installations in our Multi-Display Learning Space, with Multi-Slides configured (as in Figure 1) to allow PowerPoint slides to be displayed over 6 projectors (the three interactive whiteboards comprising the Smart Meeting Pro system on one wall, plus the three projectors used to display Thunder's flipchart pages on the adjacent wall). To illustrate the use of the Multi-Display Learning Space within this paper, we concentrate upon our experiences in using the Multi-Slides system during a series of Art History-focussed seminars within a postgraduate Classics course. The next section will focus upon our learning methodology, comparative viewing, before we analyse the affordances our space offers in terms of the requirements of that methodology.

Comparative Viewing

Comparative viewing, the description and analysis of a picture or object in relation or contrast to other objects and pictures, forms one of the most basic staples of art historical scholarship and other disciplines devoted to the study of visual arts, particularly with regard to the discussion of formal and stylistic characteristics (Nelson, 2000, p.429; Friedberg, 2006, p.196). Procedurally, comparative viewing links differing aspects of the art work to form an analytical narrative, using comparison to facilitate detailed exploration. Methodologically, its aims are to structure the process of viewing, turning it into a falsifiable heuristic exercise wherein the (in our case verbal) argument is constructed formally from the discernible features of the juxtaposed supporting materials and can thus be challenged on the same basis.

The development of comparative viewing as a method can be attributed to the conditions created by technological developments. Grimm (1892/1981), eulogised about his introduction of the *skioptikon*(lantern slide projector) to Art History, likening its use to that of a microscope within a field he hoped to re-mould along the lines of a hard science, which for him meant primarily to base its findings upon quantifiable data (ibid, p.203). Grimm's innovation was successful, and the skioptikon was rapidly adopted by the discipline across the globe within illustrated lectures which, for many, have become synonymous with the discipline itself (Dilly, 1995, pp.39-41; Nelson, 2000, p.415).

Certainly, the new visualisation technology changed the rhetoric of the discipline, from an *ekphrastic* model in which the lecturer described the objects to which they referred, to a *deictic* model where the presence of the visual evidence was *assumed* and an argument constructed based upon the identity of the orator (who spoke *on behalf of* the paintings themselves). So lecturers, no longer forced to re-enact the art work *for* their audience ekphrastically, now spoke as part of a shared experience which some have characterised as enabling greater objectivity towards the displayed works (Grimm, 1892/1981: p.204), greater plausibility for their own arguments (Nelson, 2000, pp.416-420), and a more democratic lecture which could include those insufficiently affluent to have taken a Grand Tour of European art collections (ibid, p.423). At a practical level this deictic narrative was associated with the synchronisation of image (of paintings) and narration in time within the lecture, unobtainable previously even by the passing around of photographs. This allowed for greater comparison within the narrative structure of the lecture, and for the re-establishment of the art work as a piece of evidence in its own right, "de-historicised" from overarching grand narratives (Grimm, 1892/1981, p.204; Nelson, 2000, p.431).

These methodological advantages were noted by Wölfflin (1915), who extended the use of the skioptikon further by introducing *double-projection*, the simultaneous display of two slides using two projectors which could be operated independently of each other, with the intention of opening up an exploratory field for discourse between the two items on offer. Wölfflin (ibid) used the new technology as the basis to construct an influential and integrated analytical methodology which used five binary concepts to describe art work, becoming an important foundation of formalist analysis.

The analytical superiority of such presentations was seen to lie in the use of "anchor slides" (Nelson, 2000, p.430). As Wölfflin (1958, after Fawcett, 1983, p.456) explained:

> it offers the possibility of continuously supporting the spoken word with pictorial demonstration. Not only can more examples be shown, but variants and exceptions can be brought forward without danger of distracting the hearer, since the keynote may be immediately struck anew. Finally, the lecturer has in greater measure the freedom to make

> use of exaggerations for purposes of clarification (and entertainment), inasmuch as it is in his power to retract them at any moment.

However, the introduction of the skioptikon and, later, double-projection, influenced not only the methodology of the discipline but also its spatial appearance. Where previously Art History lectures could be held in any space that could accommodate a congregation of people and was well-lit, so as to facilitate the passing around of drawings and photographs, now they required darkened rooms with projectors, large screens to project upon, and dedicated technical staff to facilitate the process. The environmental darkness combined with the brightness of the projected image has been seen to give the art work itself, or at least its slide-replica, an overwhelming, revelatory or "epiphanic" character (Dilly, 1995, p.42), while the voice of the lecturer becomes a key device to guide the audience and prefigure their viewing experience, turning the lecturer into an "ideal beholder" (Landsberger, 1924, pp.93-94) who speaks on behalf of the visual objects themselves.

Of course, from the point of view of student criticality, such an ideal positioning of the lecturer presents a problem which is further confounded since the students are inhibited from contributing by the darkness of the scenario. The role of the student, which was largely ignored in the literature of the time, seems to have been to *become convinced*. The potential for interactive viewing by the audience in a dianoetic sense, argumentationally derived from the structure of the presented evidence, is thus incompletely realised, as is the process of democratisation of the Art History lecture. This has been observed to prompt a tendency towards sleep (or even absconding mid-lecture, under cover of darkness) when the audience is composed of students rather than, for example, peers at academic conferences or enthusiasts at public lectures (Nelson, 2000, p.421).

Dual-projection, and the methodology surrounding it, survived in the classrooms of visual art disciplines until perhaps the mid-1990s, where it has now been replaced by PowerPoint as part of a process which, within the discipline, has been poorly studied and documented. It is true that some of the arguments against the uses of PowerPoint which we summarised earlier do not readily apply to its use in visual art disciplines, since art-historical argumentation tends to use a model of verbal narration structured around the pictures themselves as evidence. Hence, when PowerPoint was first introduced to these disciplines its ability to merge text and picture, or to present multiple pictures on one slide with relative ease during the process of authoring a presentation, was welcomed as an advance compared to lantern-slides.

However, in praxis, PowerPoint has forced a series of compromises which constitute backward steps for Art History and related disciplines. The low resolution associated with PowerPoint means that slides which juxtapose multiple images suffer in quality, decreasing the visualisation of evidence to such an extent that many presenters favour only a single image on each slide, thus returning to the fragmented arguments of the single skioptikon in which the spoken word must carry the comparison by describing those works which are not currently shown, *as well as* argue (structurally) and persuade (interpersonally). Like the single skioptikon, such a scenario still represents an advance over the rhetoric of the slide-less lecture, yet in reintroducing an emphasis on the verbal, PowerPoint serves to force a re-historicised argument independently of the visual evidence and the analytical focus — this serves neither the formalist approaches as inspired by Wölfflin and others nor those more focussed upon the iconological, semiotic or visual cultural analysis of art works.

In the next section we draw upon our practical experiences in using an MD-LS to teach postgraduate students in Classics using comparative viewing; in doing

so we seek to examine whether the MD-LS can offer the opportunity to revisit the methodological benefits that PowerPoint seems unable to harness. We describe the technology, the space, and the instantiation of the comparative viewing methodology we used, and we compare their relative properties. We seek to demonstrate the ways in which such formal learning can be improved through considering its components, while acknowledging the obstacles we encountered in practice and the limitations of our current version of our theories.

A Multi-Display Learning Space in practice

The primary purpose of the current section is to illustrate our use of an MD-LS environment to conduct comparative viewing, to render more concrete the relationships between learning space, technology and methodology we have described within this paper and to illustrate the ways in which a consideration of these factors, within the context of MD-LS, can lead to an improvement in the understanding of the learning which takes place. The secondary purpose of the section is to provide a tangible, specific starting point so that we can move on to more general considerations within our conclusion in a comprehensible way. We therefore seek to illustrate the rhetorical space opened up by the paper rather than provide a comprehensive study of our data, which we leave to future publications.

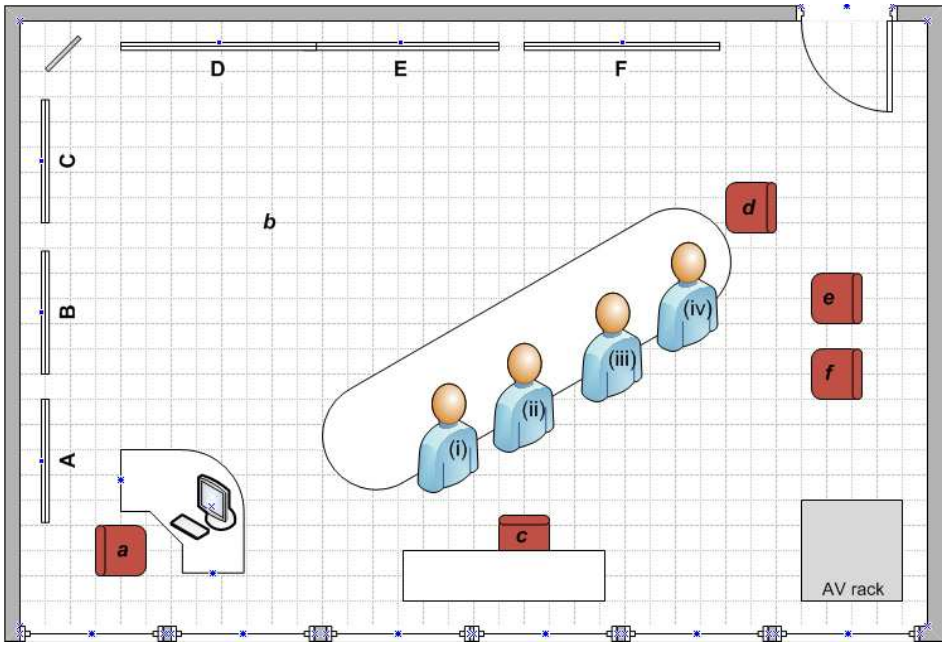

Figure 3: A diagram of the MD-LS scenario within Q8D501 Ancient Art and its Interpreters.

The MD-LS experience we report here occurred within a graduate-level module in Classics, *Q8D501 Ancient Art and its Interpreters*, during October and November 2009. The Learning Space we used was the one photographed previously within Figure 1 and described within our section on Multi-Display Learning Spaces; to benefit our analysis, we have represented the salient features of the space diagrammatically in Figure 3. Four students, (i) to (iv), sat in a diagonally-aligned row behind a lengthy surface with curved ends which is composed of three free-standing tables (a rectangle and two semi-circles) while the teacher moved more freely about the room, though generally in the positions *a* to *f*. Position *a* represents the seated location behind the computer terminal which runs the Multi-Display System software, position *b* represents the standing positions between the students and the large display screens A through F, while positions *c*, *d*, *e* and *f* represent seated positions behind and

to the side of the student cohort. Screens A, B and C are interactive whiteboards while D, E and F are projected images as described earlier; here, it is appropriate to remark that D, E, F are slightly larger than A, B, C. Two other aspects of the space are also worth noting. First, that a computer terminal adjacent to *c* did not form part of the activity and was turned off. Second, that a researcher was seated adjacent to the AV rack making use of two video cameras and a research notebook to collect data about the Learning Space. The observations we make here are derived jointly from the teacher's impressions and the researcher's notebook.

The Multi-Display System we used was *Multi-Slides* which, as we discussed earlier, has been developed as a plug-in for PowerPoint to allow presentations to be displayed across multiple screens. Once the plug-in has been installed, choosing the *Start Multi-Slide Show* option within PowerPoint causes a configuration dialog box to be displayed (Figure 4). Each of the monitors attached to the system can be included or excluded from the presentation cascade, allowing some displays to be permanently used for information outside the presentation, such as live webpages or productivity packages. The order in which the cascade makes use of the monitors can also be defined, while configurable options allow the first monitor used by the cascade to display speaker notes and the final monitor to be used to display a summary screen of four reduced slides. Within the sessions described here we cascaded the presentation across the six monitors in the order A, B, C, D, E, F, with the computer screen at position *a* duplicating the display at A.

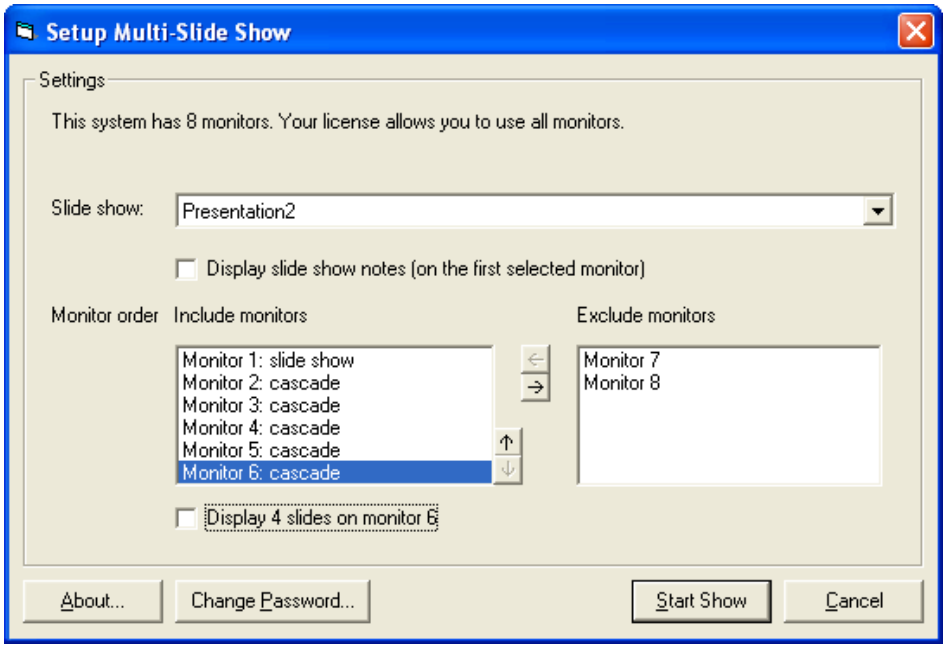

Figure 4: configuring a presentation cascade within Multi-Slides

Ancient Art and its Interpreters is a graduate-level (Master of Arts), seminar-based module in which the cohort comprises students who, during their undergraduate degrees, had differing levels of exposure to art-historical and classical archaeological content. The students are introduced to a diverse set of key contexts (a corpus of statues, vases, paintings, sarcophagi, and so on) seen through the lens of key concepts in the study of Greek and Roman art and archaeology, such as stylistic analysis, visual narrative or urbanism. The students interact with both primary and secondary evidence: each student is assigned to read a different piece of (secondary) literature prior to the session, and they are thus positioned as "experts" informed by different perspectives during the sessions, in which verbal discussion around the (primary) evidence

provided by the images is supported by the MD-LS and orchestrated by the tutor. In this way, the learning methodology seeks to create dialogue around sets of images, which have been selected by the tutor with the intention of enabling comparative viewing. Juxtaposed images included different views of the same object, intended for purposes of clarification, contrast, to illustrate a sense of narrative within the object composition, or to illustrate the importance of the viewer position. Other sets of images contextualised an object: geographically or physically, within space; against contrasting objects; culturally, making use of other representations; within a stylistic progression, and so on.

From the point of view of *technology*, the Multi-Slides system was able to display the material in a visually commanding manner, and allowed the transition between slides or sets of slides to occur quickly and unobtrusively. The system works by storing images of the finalised slides and sending them to the multiple projectors along with a bespoke transition effect; though this might have restricted the experience had information in modes such as video been required to support discussion, in this case the still images matched the requirements of the methodology quite well. On the other hand, the fact that only the most recent slide within the cascade was genuinely a live PowerPoint, in this case at position A, meant that the possibility for annotation of slides was restricted. Several instances were noted where a desired annotation rendered it necessary to traverse the presentation backwards, then annotate, then move forwards again, interrupting the flow of discourse between participants and, occasionally, being the subject of explicit comment by the tutor.

In terms of the flow of the presentation slides, the system successfully supported what we have termed a "loosened" structure, less granularly bounded in the sense that slides had been grouped conceptually into chunks, yet still linear in terms of progression. Supported by the visual affordances of the space, students were free to comment on any piece of evidence which was currently displayed (we consider whether or not they actually did so later, in relation to methodology). Yet they were still ultimately governed by the sectional transitions orchestrated by the tutor and accomplished in a spatially distributed way through the use of a common USB wireless presenter unit. In addition to annotation, which was directly supported by the system using a finger on the live board, a direct form of interaction with materials was achieved through the use of a laser pointer, a disciplinarily-favoured mode of interaction, or cultural practice, using a laser pointing device housed within the same unit as the USB wireless presenter. The system therefore supported a mode of control which could be transferred, as applicable, to individual students but which could also be utilised by the tutor: in fact, the students were observed to use the laser pointer in making their arguments very frequently, yet rarely did they advance the presentation forwards themselves, through the slides, using the same handheld unit.

From the point of view of *space*, a number of affordances were relevant to the support of learning. The field of view afforded to the students was good, and their ability to scan across the array of visual evidence using eye, head or body movements was the enabling factor for the loosened linear discussion structure which we have already described. The relative size of the screens, together with the positioning of the students, meant that imagery upon screens D, E, F was the best resolved, while the screen at A (ironically, the directly interactive live slide) was mildly problematic due to its smaller size, relative distance and least favourable angle of viewing. The overall visual resolution of the system was good, with brightly reproduced projected colour imagery dominating the room and enabling detailed inspection of evidence, although this necessitated the use of high quality imagery by the presentation author. The "information for three dimensions" (Gaver, 1992, p.19) within the space allowed for a perceptual balance to be struck by students, who could direct their attention across the

evidence, towards the tutor, towards each other, or in combinations thereof. Indeed, students seemed to possess an instinctive awareness of such balances, and used arm gestures to direct the attention of others when they were speaking themselves. Gesturing has been previously noted as important within media-supported argumentation (Lanir et al., 2008a, p.700), while the manner in which such supporting motions were engaged within this space is reminiscent of the "lookings" noted by Luff, Heath and Greatbatch (1992, p.166) within a professional context, where it was the size and position of evidence that provided the ability to monitor both gesture and materials, thereby "gaining access to the actions and activities" in which the gesturer is engaged, in our case the processes of constructing disciplinary argumentation.
The affordances for movement within the space, and their implications for learning, were considerable. Our attention to movement was first drawn by the tutor's observation that she felt *restricted* by the screens, in that few positions existed around *b* which did not result in her obstructing the students' view of the projected screens. A period followed in which the tutor favoured the seating positions *a*, *c* and *d*, but thereafter the realisation that the students tended to focus a considerable proportion of attention onto the speaker led to attempts to *direct* this attention by standing, within *b*, adjacent to the screen displaying the visual evidence upon which the tutor currently wanted the students to focus. In this way, an increased awareness of the *spatiality* within teaching was used as the basis to attempt to scaffold argumentation: an initial exemplar of analytical argumentation was accompanied by physical movement within *b*; over subsequent iterations, the attention of students was forced to become increasingly self-selected as the tutor retreated to a seated position. Position *c*, in particular, was seen as useful by the tutor due to its physical position directly behind the cohort; when the situation called for a moment of questioning or less formal discussion, the students could turn towards the tutor and converse easily, yet at a moment of analysis the students, now facing forwards, were forced to select their own point of focus, either in constructing their own argumentational narrative or in listening to that of the tutor, which became a disembodied voice within the relative darkness.

From the point of view of the *methodology*, a crucial consideration in the construction of the scenarios was the process of authoring undertaken by the tutor pre-session. Multi-Slides' integration into PowerPoint renders it unnecessary to learn a new authoring system, but also means that the authoring environment does not reflect the teaching environment in terms of the simultaneous display of materials, causing the tutor to focus more abstractly upon strategies for choreographing imagery in support of the desired pedagogical narrative. The tutor reported that the average number of slides used within the sessions approached double that for an equivalent, non-MD-LS, session, while contending that preparation time was not unduly increased since most slides now contained a single image at comparable scale, perhaps with a simple caption, rather than the time-consuming slide compositions of more traditional PowerPoint presentations where intricate balances of visual elements had to be considered. Slides within the presentations were arranged within "chunks" of six (the number being directly related to the number of display screens), with occasional individual slides to serve transitional purposes. These chunks were designed as the equivalent of individual slides within a more conventional presentation (albeit with a more consistent image scale and with screen boundaries defining information partitions) and, in introducing a sectional granularity of 6 rather than 1, were the enabling mechanism for the loosened linear discussion structure described earlier.

In-session, the Multi-Slides system supported the intended methodology well with the exception of the annotational limitations already noted. The teaching style was designed to provide suitable evidence for students to analyse, together with examples of analysis offered by the tutor to which students were

invited to disagree, comment, or offer clarifications. Though each lesson clearly had a corpus of material which was designed to be covered, the pace of teaching was relaxed in order to offer plenty of time for student contributions and original analysis. After suitable, spatially scaffolded, exemplars of analysis were offered by the tutor, the students were able to choose appropriate pieces of visual evidence from within the current slide-chunk to support their own arguments, as part of a process which saw the expert-centric methodology of comparative viewing adopted in part by the students. Thus the materials and teaching style together supported lively discussion and debate.

Perhaps one unintended consequence of the use of the MD-LS to support comparative viewing was a critique of the methodology itself. As an established methodology within visual arts, comparative viewing is intended to support the needs of the expert speaker in constructing and then enacting argumentational and performative (persuasive) discourse in front of an audience. While we were successful in engaging students with the process of arguing around images within the seminar, the space and technology here affords the potential for students to construct their own juxtapositions rather than merely reacting to those of the teacher, and we are eager to enact such student-created multimodal arguments in future work. We are also eager for students to escape from their chairs to enact the spatial movement within the process which we have currently restricted to the tutor.

This section has sketched some practical experiences with MD-LS scenarios and sought to illustrate the way in which considerations of learning technology, methodology, and space can be used to analyse Learning Spaces. In particular, we have illustrated examples of the Multi-Display Systems (technology), Multi-Display Learning Spaces (space) and Multiple Perspective Learning (methodology, in this case based around comparative viewing) which co-exist during MD-LS scenarios. In the next section, we conclude by considering how these elements might be used to support learning more generally, using a rhetorical structure for MD-LS based around notions of multimodal argumentation, enacted in real-time.

Conclusion

Within this paper we have sought to open a discussion to further the understanding of Multi-Display Systems and their effect upon learning. Though the importance of Learning Spaces within educational processes is now acknowledged much of the potential benefit remains unrealised, in part due to the unambitious view of such spaces implicit within many evaluation programmes. We have sought to address this situation through an ecological understanding of MD-LS scenarios which balances elements of learning space with those of methodology and technology. The use of MD-LS scenarios to support critical learning within disciplines can be understood through a rhetorical structure: “who is communicating to who about what, with what purpose (why?) and how?” (Andrews, 2010, p.29).

The methodology of comparative viewing used within the Classics seminars acts as a disciplinary form of argumentation which structures visual materials in relation to the statements needed to establish a position within the argument. The methodology for authoring, and the subsequent performativity of the Art Historical lecture (Nelson, 2000, pp.419-420) is an example of the *choreography* of argument (Andrews, 2010, p.39) — developing the argument, exchanging views, and relating evidence to claims and propositions. However, in establishing the lecturer as an ideal beholder, the typical Art History *lecture* manufactures a rhetorical space designed to maintain the traditional power relations between ‘rhetor’ and audience (ibid, pp.29-32).

Within the seminars we described here, such relationships between “who” and “to whom” have started to become blurred due to configurations of both space

and technology. The loosened linear structure of presentation which resulted describes an episodic format of discourse, bounded by sectional groupings of materials and the transitions between them. The power structures within episodes are still skewed towards the tutor, who has authored the materials, but less so due to the variety of views which provides the basis for development of alternative arguments, inspired by different secondary viewpoints. Similar observations have been made about the visual argumentation which occurs within film, for example by Alcolea-Banegas (2009, p.260) who has stated: "we are neither compelled to share the point of view of the filmmaker, nor entirely free to supply pragmatic inferences or critical assessments of our own".

The power structure *between* episodes, on the other hand, still lies firmly with the choreographer who decides the moments of transition, and so a key point of future investigation is to adopt the methodological and technological changes which will allow such decision-making to be distributed more widely, as well as to monitor the roles of 'rhetor' and audience and scaffold more carefully the changing of such roles within MD-LS scenarios.

In considering the "why" of such modes of communication it is necessary to consider the position of evidence within argumentation. Though the details differ by discipline (Andrews, 2010, p.81), the purpose of academic argumentation is to drill down through evidence at a point of dispute. It is difficult for a single image as visual evidence to directly argue unless the tension between multiple perspectives is implicit within it (ibid, p.103), yet such tension can indeed be manufactured through the juxtaposition of multiple images. This, simultaneously, invites a *choice* of route through the work (ibid, p.108) which creates the space for the argument of the rhetor to be challenged through alternate readings. In this way, MD-LS scenarios echo the photo essay, yet they provide space for the multi-voiced aspects associated with verbal dialogue; they also echo the presentation of multimodal video or web material, yet they provide the opportunity for real-time discussion of the case, and for the developing of shared explanations through a dialectical process within the classroom (Dowell & Asgari-Targhi, 2008). In this way, the rhetorical "what" within MD-LS can extend beyond the authoring of materials to support a central argument, providing the reflective, challenging, disjunctive and liminal (Savin-Baden, 2008, pp. 70-74) experiences which form the core aims of the Higher Education experience, within which the materials and the arguments of the rhetor are seen to be open to challenge.

It is within the context of these affordances of argumentational methodology that the development of Multi-Display Systems and, in turn, Multi-Display Learning Spaces must be viewed. The modes of content authoring, information display, control and flow, interaction and performance, and ability for permanent record offered by the technology must scaffold a process of argumentation which begins before the group convenes, supports synchronous and multiple perspective visual argumentation within small groups, and provides mechanisms for the knowledge created to feed into subsequent processes of learning. In turn, the space must offer affordances for vision, listening, speaking and movement within appropriate boundaries which will be at least partly defined by the technology itself and further complicated by its social identity. In these ways, MD-LS can not only support innovative modes of disciplinary argumentation, but also provide an exemplar for linking learning methodology, technology and space which is much needed within the context of Learning Spaces research as part of its wider mission to re-imagine learning.

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