Affordances of Innovative Learning Environments

Emerging innovative learning environments (ILEs) are designed to enable a wider pedagogical repertoire than traditional classrooms. In order to transcend stereotypical understandings about how the physical environment in schools may afford teaching and learning activities, it is becoming increasingly recognised that both design and practice reconceptualisation is required for affordances of new learning environments to be effectively actualised in support of contemporary education.

1. Introduction

Traditionally, school buildings have been designed largely to support teacher-centred instruction. However, in Australia, New Zealand and parts of northern Europe, many new learning spaces are being designed to enable a wider range of pedagogies. These may be identified as innovative learning environments (ILEs) [1].

With an emphasis on the affordances of ILEs, Cleveland [2] (p. 93) characterised these environments as "learning spaces that provide a greater degree of spatial variation, geographic freedom and access to resources for students and teachers than traditional classrooms". Subsequently, Imms, Mahat, Byers and Murphy [3] identified ILEs as the product of innovative space designs and innovative teaching and learning practices, highlighting the importance of relations between space and behaviour. This and related discourse [4][5] reveals parallels with Gibson's [6] affordance theory—which describes the complementarity of the environment and user in perceiving a range of action possibilities—and indicates developing recognition in the literature that learning spaces and pedagogies are intrinsically linked.

Analysing the relationships between architectural spaces and pedagogical practices is salient at a time when educational objectives are being reviewed in schools around the world amidst shifting economic, political, cultural and social agendas. For example, the Organisation for Economic Co-operation and Development (OECD) has promoted innovative learning environments [1] and innovative learning systems [7] as key components of reforms needed to support learners to thrive in the 21st century. Concurrently, educators of global influence have promoted the need for change, particularly with respect to pedagogies aimed at supporting 21st century skills development. Fullan and Langworthy [8] and Fullan, Quinn and McEachen [9] advocated for 'deep learning' climates that may help generate new relationships with and between learners, their families, communities and teachers and that deepen human desire to connect with others to do good—contributing to the development of the skills needed to thrive in a modern world.

Monahan's [10] 'built pedagogy' construct has also aided recent interpretations of space–pedagogy relationships. He suggested that, throughout history, the creation of school spaces has been closely aligned with educational philosophies. He commented that:

> "Architects, educational philosophers and teachers know well the force that spatial configurations exert on people—how they shape what actions are possible, practical, or even conceivable. Because space constrains certain actions and affords others, the design and layout of space teaches us about our proper roles and places in society"
>
> ([10], p. 8).

The concept of 'affordances' was coined by James Gibson in the 1970s. Since then, his theory that the environment may offer 'the animal' a range of 'action possibilities' has been applied and re/interpreted by researchers from varying fields. Commonly, these have included psychology [6][11][12][13][14][15][16][17][18][19][20][21][22], technology/Human–Computer Interaction (HCI) design [23][24][25][26][27][28][29][30][31] and anthropology [32].

However, prior to Gibson's development of the term and theory of 'affordances', the principles behind the theory can be recognised in the approaches of school architects: principally Herman Hertzberger [33][34], who promoted school typologies that varied from traditional classroom designs to enable more diverse pedagogical practices. In 1969, Hertzberger [33] specifically discussed relationships between 'users' and 'things' when describing his approach to the architectural design of the innovative Montessori Primary School in Delft. He wrote:

> "The aim of the architecture is then to reach the situation where everyone's identity is optimal, and because user and thing affirm each other, make each other more themselves, the problem is to find the right conditioning for each thing. It is a question of the right articulation, that things and people offer each other. Form makes itself, and that is less a question of invention than of listening well to what person and thing want to be"
>
> ([33], p. 64).

The discourse generated by Hertzberger [33] about the relationships between the environment and users reveals synergies with Gibson's later descriptions of affordances, including his most cited definition found in *The Ecological Approach to Visual Perception* [6]:

> "The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill.The verb to afford is found in the dictionary, but the noun affordance is not. I have made it up. I mean by it something that refers to both the environment and the animal in a way that no existing term does. It implies the complementarity of the animal and the environment"
>
> ([6], p. 127).

Researchers critically reviews the body of literature on affordances as it relates to the design and pedagogical inhabitation of school buildings. In doing so, links between education, architectural design and affordance theory are explored within the context of shifting perspectives on what constitutes effective teaching and learning practices in schools.

By critiquing applications of affordance theory conducted by researchers from varying disciplines, contested ideas surrounding the theory are highlighted, including varying and sometimes contradictory interpretations of Gibson's original concept [27][29][35]. Opportunities for applying Gibson's theory to develop new insights into the relationships between space and pedagogy are also discussed, offering a foundation for future research into the action possibilities of learning spaces for school teachers and students.

2. Innovative Learning Environments (ILEs)

Formal schooling, was established in the nineteenth and early twentieth centuries, based on a subject-focused curriculum delivered didactically in traditional classrooms [36]. Since then, school buildings have largely been designed to reflect and enable teacher-centred instruction. However, many newer learning spaces, as may be identified as ILEs, are being designed to enable a wider range of pedagogies [37].

Intended to enable a shift from teacher-centred instruction to student-centred learning [1][38][39], the pedagogies within these new socio-spatial environments are anticipated to feature collaborative, participatory, and agentic teaching and learning approaches that may help engage students as "active participants in their own learning" [40] (p. 74) and "encourage and enable students to learn in ways that allow them to attain their personal academic and social potential" [41] (p. 65).

Physically, ILEs often exhibit an array of different spaces, learning materials and ways for people to interact with each other [40]. To illustrate the distinction between traditional classrooms and ILEs, the images below depict a small secondary school building that was re-developed into an ILE at a school in Sydney, Australia. The re-development transformed a 1980s classroom block into an ILE featuring a variety of interconnected learning spaces or settings, each expected to afford different modes of teaching and learning（**Figure 1**）.

Figure 1. A range of settings to accommodate different teaching and learning modes, and activities

This new environment at the school can accommodate up the 75 students (equivalent to three classes, as opposed to the original four) and provides opportunities for the collaborative teaching of multiple classes. The building features zones for large group gatherings and explicit teaching as well as smaller areas for small group and independent work. Spaces include writeable surfaces (walls and table-tops) that enable students to work in groups and to share their thinking. A range of setting types, including tiered seating areas, settings defined by high tables, booth seating areas and a boardroom-style space, provide students with options to pursue varied learning activities.

As shown in this example, ILEs tend to be rich with affordances for learning. However, research suggests that these may not be well understood generally by designers or teachers [42][43]. Therefore, whilst there is widespread understanding about how traditional classrooms 'work', it appears that there is not common understandings about the pedagogical possibilities of ILEs [42].

Insights into the relationships between the environment and user may be considered central to how learning environments are perceived and productively used (inhabited). When writing about Gibson's ideas about perception in *Anthropology and/as education*, Ingold [44] (p. 31) stated that "the perceptual system of the skilled practitioner resonates with the properties of the environment". He suggested that an 'education of attention' may be undertaken as educators notice and "respond fluently to environmental variations and to the parametric invariants that underwrite them" (p. 31). As such, understandings about affordances and how they relate to school design and educational practice is needed in support of effective teaching and learning. Adopting an affordance-based approach to design is likely to help generate shared understandings between architects and users, aiding in the creation of spaces that are not only well-designed but also well-used in practice.

3. Affordance Theory as Interpreted through the Lens' of Architecture and Learning Environment Design

Whilst affordances have often been discussed in fields such as psychology, environmental psychology and technology (e.g., Human–Computer Interaction (HCI) design), affordance theory has been less present in architectural discourse.

3.1. Affordance Theory in Architectural Discourse

Mention of affordance theory in architectural discourse is sparse yet not completely absent. With respect to the design of physical environments, Heft [45] suggested that there is a strong argument for a more affordance-based approach to design yet a lack of literature exists about the experience of users within spaces. He wrote:

> *"Designers interested in how particular environments are utilized and experienced quite reasonably might turn to the environmental psychology research literature for guidance. They are likely to be disappointed. Although there is an extensive literature addressing how individuals assess environments (or rather environmental surrogates) on rating scales, information is sorely lacking about how environments are experienced by users in the course of action"*
>
> ([45], p. 22).

Over recent decades, affordances have been discussed and explored within the fields of technology/HCI design [26][28][46], architecture [47][48][49][50][51], interior design [52][53] and product design [54]. However, as noted by Heft [45], affordance theory has been less present in architectural discourse than in many other design fields. This is perhaps surprising given that Gibson [6] challenged architects and designers to adopt a theory of affordances to encompass their understanding of materials into a system. Heft [55] also noted this as being curious, given that the architectural design process is based around understandings of how building elements provide function for users. Furthermore, Maier et al. [50] argued that the lack of references to affordances within architecture relates to historical separations of form and function dating back to the writings of Vitruvius, in which form (firmitas), function (utilitas) and beauty (venustas) were considered separate but competing requirements. They proposed that affordance theory could be deployed to unite the originally separate Vitruvian ideas of form and function.

Similarly, Koutamanis [49] and Sporrel, Caljouw and Withagen [56] discussed designers' competing considerations with respect to form and function. Koutamanis [49] suggested that there is a perception that architects intuitively address affordances as part of their training and practice but noted that this is not necessarily the case as they primarily perceive design through a visual and aesthetic lens, generating differences between designer's and user's perspectives and perceptions. He felt that "users can be flexible, adaptable and tolerant to design limitations despite constant irritation and frustration" [49] (p. 357). This, he suggested, allows architects to be selective in what they deem important and "insensitive to practical problems that conflict with higher, usually aesthetic norms" (p. 357). Sporrel et al. [56] (p. 136), too, noted that "designers are often driven by aesthetic motives".

Koutamanis [49] argued that the adoption of an affordance perspective could help correlate designers' and users' perceptions, promoting opportunities for design innovation and reducing "the danger of falling back to stereotypical solutions and arrangements" [49] (p. 357). He concluded that "the main target of affordances in architectural design is the enrichment of the architects' perception" [49] (p. 361).

Heft [57] suggested that, if design professionals better understood the nature of affordances, including the relationship between latent affordances and the actual use of environments, they may pay more attention to the ways in which environmental cues can be designed into settings to enable use. He also noted that, whilst designers do consider function as part of their work, the descriptive language they often use is largely form-oriented. He went on to suggest that this may hinder their ability to adequately incorporate function into their designs [58].

3.2. Applications of Affordances in Architecture

A small number of researchers within the architecture and interior design disciplines have suggested various ways that affordances could be understood in relation to buildings [47][50][51][52][53]. It must be said, however, that a number of these suggestions have strayed (possibly too far) from the origins of affordance theory, with its emphasis on psychological perception.

Galvao and Sato [54] developed a Function–Task Interaction Method to analyse affordances in product design. Kim et al. [52] subsequently adapted this to suit interior design contexts. They proposed three key aspects to consider:

- *Space*—including building components such as floors; ceilings; columns; walls; and door and window openings, which enable the flow of movement between spaces;

- *Objects*—including fixtures, fittings and furniture as well as technological equipment and personal belongings, such as pens and paper;

- *Social activities and tasks*—including a range of diverse interactions between people (human–human interactions), including communication, socialising, discussion and presentations.

The affordance analysis framework developed by Kim et al. [52] represents perhaps the most sympathetic interpretation of Gibson's theory with respect to a built environment. Nevertheless, the range of interpretations of affordances across

multiple disciplines, including within architecture, remains a source of confusion, with some researchers even questioning the validity of the concept [29].

3.3. Affordance Theory in Learning Environment Design

Within the world of architecture, affordance theory has received perhaps more attention in educational facility design [59][60][61][62][63] than in any other built environment sector. However, its application in 'learning environment research' has not been immune to the uncertainty identified above, and there remains limited discourse about its suitable interpretation and application.

Of the academic papers that refer to affordances in the context of learning environments, Alterator and Deed [63] referenced Greeno [14] (p. 2) to define affordances as "aspects of an environment that enable, contribute to, or constrain the kinds of interactions that subsequently occur". Taking their cue from the affordance analysis framework by Kim et al. [53], Young et al. [42] (p. 697) subsequently offered a definition that identified 'learning environment affordances' as "qualities of the environment (space, objects and people) which may be perceived to enable teaching and learning activities and behaviours".

References

1. OECD. Innovative Learning Environments; OECD Publishing: Paris, France, 2013.

2. Cleveland, B. Emerging methods for the evaluation of physical learning environments. In Evaluating Learning Environments: Snapshots of Emerging Issues, Methods and Knowledge; Imms, W., Cleveland, B., Fisher, K., Eds.; Sense Publishers: Rotterdam, The Netherlands, 2016; Volume 8, pp. 93–106.

3. Imms, W.; Mahat, M.; Byers, T.; Murphy, D. Type and Use of Innovative Learning Environments in Australasian Schools ILETC Survey No. 1; University of Melbourne: Melbourne, Australia, 2017; Available online: http://www.iletc.com.au/publications/reports/ (accessed on 30 October 2021).

4. Mulcahy, D.; Cleveland, B.; Aberton, H. Learning spaces and pedagogic change: Envisioned, enacted and experienced. Pedagog. Cult. Soc. 2015, 23, 575–595.

5. Saltmarsh, S.; Chapman, A.; Campbell, M.; Drew, C. Putting 'structure within the space': Spatially un/responsive pedagogic practices in open-plan learning environments. Educ. Rev. 2015, 67, 315–327.

6. Gibson, J.J. The Ecological Approach to Visual Perception; Houghton-Mifflin: Boston, MA, USA, 1979.

7. OECD. Schooling Redesigned: Towards Innovative Learning Systems; OECD Publishing: Paris, France, 2015.

8. Fullan, M.; Langworthy, M. Towards a New End: New Pedagogies for Deep Learning; Pear Press: Seattle, WA, USA, 2013.

9. Fullan, M.; Quinn, J.; McEachen, J. Deep Learning: Engage the World, Change the World; Corwin: Thousand Oaks, CA, USA, 2018.

10. Monahan, T. Globalization, Technological Change, and Public Education; Routledge: New York, NY, USA, 2005.

11. Chemero, A. An outline of a theory of affordances. Ecol. Psychol. 2003, 15, 181–195.

12. Costall, A. Socializing affordances. Theory Psychol. 1995, 5, 467–481.

13. Gibson, E.J.; Pick, A. An Ecological Approach to Perceptual Learning and Development; Oxford University Press: Cary, NC, USA, 2003.

14. Greeno, J.G. Gibson's affordances. Psychol. Rev. 1994, 2, 336.

15. Michaels, C.F. Affordances: Four points of debate. Ecol. Psychol. 2003, 15, 135.

16. Reed, E. Encountering the World: Toward an Ecological Psychology; Oxford University Press: Oxford, UK, 2012.

17. Rietveld, E.; Kiverstein, J. A rich landscape of affordances. Ecol. Psychol. 2014, 26, 325–352.

18. Shaw, R.; Turvey, M.; Mace, W. Ecological psychology: The consequence of a commitment to realism. In Cognition and the Symbolic Proceses II; Weimer, W., Palermo, D., Eds.; Erlbaum: Hillsdale, NJ, USA, 1982; pp. 159–226.

19. Stoffregen, T.A. Affordances and events. Ecol. Psychol. 2000, 12, 1–28.

20. Stoffregen, T.A. Affordances and events: Theory and research. Ecol. Psychol. 2000, 12, 93–107.

21. Turvey, M.T. Affordances and prospective control: An outline of the ontology. Ecol. Psychol. 1992, 4, 173.

22. Warren, W.H., Jr. Perceiving affordances: Visual guidance of stair climbing. J. Exp. Psychol. Hum. Percept. Perform. 1984, 10, 683–703.

23. Gaver, W. Techology affordances. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, New Orleans, LA, USA, 27 April–2 May 1991; pp. 79–84.

24. Gaver, W. Affordances for interaction: The social is material for design. Ecol. Psychol. 1996, 8, 111–129.

25. Leonardi, P.M. When does technology use enable network change in organizations? A comparative study of feature use and shared affordances. MIS Quaterly 2013, 3, 749.

26. Lindberg, A.; Lyytinen, K. Towards a theory of affordance ecologies. In Materiality and Space. Technology, Work and Globalization; de Vaujany, F., Mitev, N., Eds.; Palgrave Macmillan: London, UK, 2013; pp. 41–61.

27. McGrenere, J.; Ho, W. Affordances: Clarifying and evolving a concept. In Proceedings of the Graphics Interface 2000 Conference, Montréal, QC, Canada, 15–17 May 2000.

28. Norman, D. The Psychology of Everyday Things; Basic Books: New York, NY, USA, 1988.

29. Oliver, M. The problem with affordance. E-Learn. Digit. Media 2005, 2, 402–413.

30. Pea, R. Practices of Distributed Intelligence and Designs for Education; Cambridge University Press: New York, NY, USA, 1997.

31. Shaw, A. Encoding and decoding affordances: Stuart Hall and interactive media technologies. Media Cult. Soc. 2017, 39, 592–602.

32. Ingold, T. Bindings against boundaries: Entanglements of life in an open world. Environ. Plan. A 2008, 40, 1796–1810.

33. Hertzberger, H. Montessori primary school in Delft, Holland. Harv. Educ. Rev. 1969, 39, 58–67.

34. Hertzberger, H. Space and Learning: Lessons in Architecture 3; 010 Publishers: Rotterdam, The Netherlands, 2008.

35. Harwood, S.; Hafezieh, N. 'Affordance'—What does this mean? In 22nd UK Academy for Information Systems International Conference: Ubiquitous Information Systems: Surviving & Thriving in a Connected Society Oxford; Griffiths, M., McLean, R., Kutar, M., Eds.; St. Catherine's College: Oxford, UK, 2017.

36. Burke, C.; Grosvenor, I. School; Reaktion: London, UK, 2008.

37. Imms, W. Can Altering Teacher Mindframes Unlock the Potential of Innovative Learning Environments? 2016. Available online: http://www.iletc.com.au/wp-content/uploads/2016/03/ILETCOverview-brochure-printable.pdf (accessed on 30 October 2021).

38. Dovey, K.; Fisher, K. Designing for adaptation: The school as socio-spatial assemblage. J. Archit. 2014, 19, 43–63.

39. Imms, W.; Cleveland, B.; Fisher, K. Evaluating Learning Environments: Snapshots of Emerging Issues, Methods and Knowledge; Sense Publishers: Rotterdam, The Netherlands, 2016.

40. Cleveland, B. Equitable pedagogical spaces: Teaching and learning environments that support personalisation of the learning experience. Crit. Creat. Think. 2009, 1, 59–76.

41. Mahat, M.; Bradbeer, C.; Byers, T.; Imms, W. Innovative Learning Environments and Teacher Change: Defining Key Concepts; Technical Report; LEaRN; University of Melbourne: Melbourne, Australia, 2018.

42. Young, F.; Cleveland, B.; Imms, W. The affordances of innovative learning environments for deep learning: Educators' and architects' perceptions. Aust. Educ. Res. 2019, 47, 693–720.

43. Lackney, J. Teacher environmental competence in elementary school environments. Child. Youth Environ. 2008, 18, 133–159.

44. Ingold, T. Anthropology and/as Education; Routledge: Abington, UK, 2018.

45. Heft, H. Affordances and the perception of landscape: An inquiry into environmental perception and aesthetics. Innov. Approaches Res. Landsc. Health Open Space People Space 2010, 2, 9–32.

46. Norman, D. Affordance, conventions, and design. Interactions 1999, 6, 38–43.

47. Atmodiwirjo, P. Space affordances, adaptive responses and sensory integration by autistic children. Int. J. Des. 2014, 8, 35–47.

48. Jelić, A.; Tieri, G.; De Matteis, F.; Babiloni, F.; Vecchiato, G. The enactive approach to architectural experience: A neurophysiological perspective on embodiment, motivation, and affordances. Front. Psychol. 2016, 7, 481.

49. Koutamanis, A. Buildings and affordances. In Design Computing and Cognition '06; Gero, J.S., Ed.; Springer: Dordrecht, The Netherlands, 2006; pp. 354–364.

50. Maier, J.; Fadel, G.; Battisto, D. An affordance-based approach to architectural theory, design, and practice. Des. Stud. 2009, 30, 393–414.

51. Tweed, C. Highlighting the affordances of designs. In Computer Aided Architectural Design Futures 2001; de Vries, B., van Leeuwen, J., Achten, H., Eds.; Springer: Dordrecht, The Netherlands, 2001; pp. 681–696.

52. Kim, Y.S.; Jeong, J.Y.; Kim, M.K.; Lee, S.W.; Kim, M. Personal cognitive characteristics in affordance perception: Case study in a lobby. In Emotional Engineering: Service Development; Fukuda, S., Ed.; Springer: London, UK, 2011; pp. 179–206.

53. Kim, Y.S.; Kim, M.K.; Lee, S.W.; Lee, C.S.; Lee, C.H.; Lim, J.S. Affordances in interior design: A case study of affordances in interior design of conference room using enhanced function and task interaction. In Proceedings of the ASME 2007 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference, Las Vegas, NV, USA, 4–7 September 2007.

54. Galvao, A.B.; Sato, K. Affordances in product architecture: Linking technical functions and user requirements. In Proceeding of the ASME Conference on Design Theory and Methodology, Long Beach, CA, USA, 24–28 September 2005.

55. Heft, H. Affordances and the body: An intentional analysis of Gibson's ecological approach to visual perception. J. Theory Soc. Behav. 1989, 19, 1–30.

56. Sporrel, K.; Caljouw, S.; Withagen, R. Gap-crossing behavior in a standardized and a nonstandardized jumping stone configuration. PLoS ONE 2017, 12, e0176165.

57. Heft, H. An examination of constructivist and Gibsonian approaches to environmental psychology. Popul. Environ. 1981, 4, 227–245.

58. Heft, H. Affordances of children's environments: A functional approach to environmental description. Child. Environ. Q. 1988, 5, 29–37.

59. Cleveland, B. Engaging Spaces: Innovative Learning Environments, Pedagogies and Student Engagement in the Middle Years of School. Ph.D. Thesis, The University of Melbourne, Melbourne, Australia, 2011.

60. Woodman, K. Re-Placing Flexibility: An Investigation into Flexibility in Learning Spaces and Learning. Ph.D. Thesis, The University of Melbourne, Melbourne, Australia, 2011.

61. Woolner, P.; McCarter, S.; Wall, K.; Higgins, S. Changed learning through changed space: When can a participatory approach to the learning environment challenge preconceptions and alter practice? Improv. Sch. 2012, 15, 45–60.

62. Burke, C. Looking back to imagine the future: Connecting with the radical past in technologies of school design. Technol. Pedagog. Educ. 2014, 23, 39–55.

63. Alterator, S.; Deed, C. Teacher adaptation to open learning spaces. Issues Educ. Res. 2013, 23, 315–330.