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A Framework of Factors for Learning Environment Evaluation

Graeme Oliver

ORCID: https://orcid.org/0000-0003-1963-4882

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Abstract

There is a common assumption that the provision of innovative learning environments in schools will lead to the subsequent implementation of appropriate innovative approaches to teaching and learning in these facilities. However, there is not a strong body of research that interrogates the nature of the relationships and outcomes that occur in the complex interactions between new learning environments and education practices.

This research developed a framework to facilitate the evaluation of innovative education practices in innovative learning environments. The purpose of the framework is to help practitioners best identify their particular situation and circumstances for evaluation of identified aspects of the relationship between learning environments and teaching and learning practices. This supports the premise that better judgements about evaluation will facilitate the development of better understandings of issues related to the implementation of innovative education practices in innovative learning environments.

The framework for research was developed using an approach based on Conceptual Modelling. The details of the framework were derived from the literature review deliberately incorporating a cross-disciplinary perspective of literature that drew on the fields of architecture and education facility design and education practice with a particular orientation to teaching and learning in innovative learning environments.

The capacity of the framework to achieve its intended purposes was investigated through a research process of Expert Elicitation. The research methodology of Expert Elicitation was very effective in generating a valid pool of data from a small focussed group of respondents.

Analysis of the data showed that experts from backgrounds in both architecture and education strongly agreed on factors considered to be the most significant in relation to the implementation of innovative education practices in innovative learning environments. These factors were centred around concepts of education principles, stakeholder connection and student engagement.

Qualitative data analysis identified a revised structure to the framework that could best represent the key findings of the research. The framework allows for dynamic interpretation of the declared set of key issues that were identified. Guidelines for making decisions about interpretation of the evaluation framework are given through descriptions of the key purpose statements, guiding questions and consideration of the nature of evaluation to be utilised. Consequently, the key factors in the framework may be adapted to cater for different contextual settings as well as differing interpretations of key ideas associated with the evaluation of innovative education practices in innovative learning environments.

This study presents two significant outcomes: a) the framework which was developed through the research that brings focus and coherence to the evaluative situation; and b) the questionnaire that was developed for use by specific groups to aid in their own situation specific interpretation of the framework. Both the framework and the questionnaire represent a balanced integration of the perspectives of architects and educators with respect to implementing innovative education practices in innovative learning environments.

Declaration

I certify that:

1. this thesis comprises my original work except where indicated otherwise
2. due acknowledgement has been made in the text to all other material used
3. this thesis is fewer than 50,000 words in length, exclusive of tables, diagrams and appendices.

Graeme Oliver, July 2019

Preface

Coursework subjects completed/recognised separately:

- EDUC90620 Reading Educational Research
- EDUC90729 Conducting Educational Research
- EDU90335 Minor Project in Education
- EDUC90320 Doctoral Research Seminar
- EDUC90319 Doctor of Education Thesis Proposal
- EDU90335 Minor Education Project

The following publications presented material from this research that in turn helped in further development of the research:

Oliver, G. (2016). Developing new learning environments: Co-constructing innovation in education practice. In W. Imms, B. Cleveland, & K. Fisher (Eds.), *Evaluating learning environments: Snapshots of emerging issues, methods and knowledge*. The Netherlands: Sense.

Comment – This paper was based on the presentation made at the seminar "Learning Environment Evaluation: What Works? Talking Spaces 6", UniMelb, August 2014. The paper was subject to peer review to be accepted for publication. The development of the paper helped inform the critical understanding of material presented mainly in Chapters 1 & 2 of this thesis.

Oliver, G. (2017). A Situational Profile for Learning Environment Evaluation. In H. Mitcheltree, B. Cleveland, & W. Imms (Eds.), *What's Working? Informing Education Theory, Design and Practice through Learning Environment Evaluation*. Melbourne: University of Melbourne.

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Chapter 1: Introduction

Overview

It is widely acknowledged amongst educators that teachers' roles and the nature of education have changed dramatically in recent years. Significant social and cultural changes such as the ubiquitous presence of modern technologies in classrooms and educational expectations promoting more student-centric pedagogies have contributed to change teaching practices and the operating cultures of schools. This has created shifts in expectations of what teaching approaches are considered most appropriate and subsequent changes in expectations about what physical learning environments could and should be like. Innovative approaches in architecture and learning space design responding to such educational imperatives have given rise to the construction of a range of school infrastructures that seem radically different from traditional teacher-centric classrooms.

There is a common assumption that when physical learning environments offer resources and possibilities that support new teaching methods and learning goals that schools are more likely to change their teaching practices and operating cultures in line with expectations about innovation. There is not a strong body of evidence, however, that examines the nature of this relationship. Hence, there are many building projects in schools that are delivering innovative learning spaces that are driven more by optimism and hope for achieving innovative educational outcomes than with a clear understanding of how the relationship with learning space might best work.

The purpose of this research was to develop a framework to facilitate the evaluation of innovative education practices in innovative learning environments. The need for more sophisticated approaches to the evaluation of the effectiveness of new learning environments in facilitating new education practices has emerged in recent years in the manner described above with such evaluation being seen as needed to address matters ranging from a utilitarian focus on value for money in education facilities to an aspirational focus on the realisation of educational goals and ambitions in innovative facilities. The systematic use of evaluation in this context will help build an evidence-based body of knowledge and understanding that can be used to inform decision making in subsequent similar or related projects.

The development of the framework in this research was based on the premise that better judgements about evaluation tools, techniques and methods will be made if people are able to tailor evaluation approaches to their specific purposes and needs. The research created a framework that allows users to develop a profile of significant factors appropriate to their particular innovative education project in an innovative learning environment that, in turn, helps to identify the most appropriate approach to evaluation for that circumstance.

The framework developed through this research does not impose one particular evaluation tool or technique on all projects but allows for the explicit connection of evaluations that follow similar protocols, providing an evaluation outcome appropriate to each particular project. The research explored how the professional practices of architects involved in learning space design and educators involved in implementing innovative programs in new learning spaces come together. The research had a cross-disciplinary orientation in both academic research and the consideration of its application to professional practice.

Context

In the introduction to his book on the architecture of schools Dudek (2000) claims "Education and its exemplification in buildings and environments has always been concerned with radical ideas set in new and stimulating settings" (p. xiii). He refers to the partnership work between John Dewey and Frank Lloyd Wright in the United States as a leading example of how radical educational ideas were given new architectural forms in a range of specifically commissioned school designs.

Kuuskorpi and Gonzales (2011), when conducting a multi-country research project for the Organisation for Economic Cooperation and Development (OECD) Centre for Effective Learning Environments (CELE), offered a different perspective on the historical relationship between education and learning space design.

> The basic structure of teaching spaces does not seem to have evolved much over the past century. ...despite the recent changes in pedagogy and the widespread use of information technology inside classrooms and school spaces, the physical learning environment has not yet changed in keeping with this evolution (p. 2).

There are two complex challenges embedded in the contexts described above. One is in determining how we know what the best physical learning environment is to support the desired innovations in teaching practices and school operating cultures. Related to this is the need to know if the desired changes do come about when new learning environments are constructed.

Growth in the variety of new education facilities across Australia and internationally in recent years that has created a need to evaluate these learning environments "to determine which are best at supporting desired teaching and learning practices, activities and behaviours" (Imms, Cleveland, & Fisher, 2016, p. 92). Cleveland and Fisher (2013) suggested that evaluations of learning environments need to become more sophisticated and should especially include the following features: more rigorous methodologies and methods, an interdisciplinary approach that includes the perspectives of both educators and education space designers, and the use of formative evaluation methods which can support the evaluation of educational facilities throughout their lifecycle.

Lee and Tan (2008) highlight that evaluation of learning spaces is not normally done by "experts" in the field and that evaluations of learning spaces have been "limited in depth, rigour and theoretical grounding, and heavily reliant on informal and anecdotal evidence" (p. 3). Imms (2016) suggests that recent work in the field has been "too particular in focus and method, and therefore being limited in its usefulness to practitioners" (p. 19).

While the research cited above advocates for more sophisticated approaches to the evaluation of new learning environments Blackmore et al (2012) warn of the complexities that exist when considering the relationship between learning environments, innovation in education practices and meaningful evaluation. She argues that learning spaces are social spaces as well as places of formal instruction and that a range of interactions constantly change the nature, use and experience of space. The relationships between learning space and practices of pedagogy are only one factor among many in the complex relationships of teaching that inform learning outcomes. Blackmore et al argue that there is not a simple linear relationship between learning spaces, their uses and student learning outcomes, but that learning spaces

can create conditions and mediate relationships that will influence student learning along a range of indicators.

Blackmore et al further propose that there is a temporal dimension to the production, use and effect of learning spaces. When considered over time there are likely to be organisational changes as well as pedagogical changes that will influence the way space is used and the nature and outcomes of student learning.

This research recognises the existence of many effective strategies for the evaluation of learning environments attempting to deal with these complexities developed in recent years. The long-term work of the Program of Educational Buildings / Centre for Effective Learning Environments for the OECD provides excellent empirical examples of this. However, there are weaknesses in utilising these in real world circumstances, especially in bringing the perspectives and professional practices of both architects involved in the design of education facilities and educators involved in the long-term use of these facilities together.

The focus of this research

This research responded to the issues raised above in three ways. The first was in developing a framework that provides conceptual coherence in considering the relationship between innovative education practices and innovative learning environments. The framework proposed for this research was developed in the first instance using a Conceptual Modelling approach (Robinson, 2008a, 2008c, 2011) in shaping a literature review. The literature was deliberately drawn from the fields of architecture and education. The framework represented the views of both architects and educators to develop shared understandings of the described field. Details of the development of the framework are presented in Chapter 3 of this thesis.

Secondly, this research identified a set of particular issues situated within this framework that were seen as most significant for evaluation in the implementation of innovative education practices in innovative learning environments. The appropriateness of the set of issues was examined through the research methodology of Expert Elicitation (Meyer & Booker, 2001). Expert Elicitation has a pragmatic orientation that supports practitioners in their specific working situations. The research undertaken using Expert Elicitation allowed for the perspectives of both practising architects and educators to be used to identify the most significant issues to be investigated for subsequent evaluation. Details of the implementation of the Expert Elicitation methodology to identify the most significant issues are presented in Chapter 4 of this thesis.

Thirdly, the process of identifying the most significant issues (the research questionnaire) provided a tool and a process that can be used in further situations to develop a profile of issues seen as most significant and relevant to each situation. This helps achieve the pragmatic outcome of identifying the most useful evaluation approach to be used in any particular situation. Details of how the most significant set of issues were identified are presented in Chapter 5 of this thesis.

These three foci are not discrete but are constantly iterative. While the conceptual coherence of the framework initially shaped the issues seen to be most appropriate to include in the framework, feedback through the Expert Elicitation process refined the set of issues and this in turn had an influence on considering the appropriateness of the framework. Detailed

analysis of the implications for various iterations of the framework and the sets of issues is presented in Chapter 6 of this thesis.

The development of the framework relates to the overarching research question of the E21LE project "How can we determine which learning environments best support 21st century pedagogies?". The development of a framework was to provide a conceptual map so practitioners can best identify their particular situation and circumstances for evaluation in the complex field of relationships between learning environments, teaching and learning practices and learning outcomes. This approach helps users to identify and adapt which tool, technique or approach to evaluation from a known framework in the field would be most appropriate to their purposes rather than attempting to develop or identify a specific evaluation tool or technique.

The conceptual organisation and details of content for the framework were developed from a literature review encompassing both architectural and education perspectives. The development of the framework followed the Conceptual Modelling methodology of identifying objectives, outputs, inputs and content. The purpose of the literature review was to gain an overview of the field and an understanding of the specific issues that were being reported as significant in the field. There have been a series of substantial literature reviews in the field published in recent years (Blackmore et al., 2011; Cleveland & Fisher, 2013; Fraser, 2013; Higgins, Hall, Wall, Woolner, & McCaughey, 2005; Lee & Tan, 2008; Temple, 2007) and these provided a sound basis for the current study. The literature review for this research identified nineteen frameworks or models presented in relation to innovative education practices in innovative learning environments. The frameworks identified were drawn from a background in architecture with an orientation to post occupancy evaluation and building performance evaluation, and education with an orientation to school systems evaluation. The Conceptual Modelling approach used in conjunction with the literature review was the first phase of data collection for this research. As such, it provided coherence and rigour to the framework developed for the subsequent Expert Elicitation research.

Research topic and research questions

The topic for this was the development of a framework to facilitate the evaluation of innovative education practices in innovative learning environments. There were two guiding questions for the research:

1. How should a framework to facilitate the evaluation of innovative education practices in innovative learning environments be structured?
2. What factors should be included in a framework for the evaluation of innovative education practices in innovative learning environments?

Following from these guiding questions there were a series of more specific questions to inform the analysis and interpretation of data gathered through the literature review and Expert Elicitation research:

a. What factors do experts see as extremely significant for the evaluation of innovative education practices in innovative learning environments?
b. What factors do experts see as not significant for the evaluation of innovative education practices in innovative learning environments?

    c. What factors should be included in a framework for the evaluation of innovative education practices in innovative learning environments?

    d. How can a framework for the evaluation of innovative education practices in innovative learning environments be used to facilitate the selection and implementation of the most appropriate approaches to the evaluation for identified situations in the field?

These questions were examined from the perspectives of architects and educators who have a recognised interest and professional expertise in the field of developing new learning environments and implementing innovative education programs in such learning environments.

Research approach – theoretical framing

The research approach for this study had a pragmatic orientation. Morgan (2014b) argues that pragmatism can serve as a philosophical program for social research that can accommodate qualitative, quantitative and mixed methods approaches. Johnson and Onwuegbuzie (2004). propose that as a framing concept pragmatism focusses on the immediate practicality of issues and offers a practical and outcomes-oriented method of inquiry that is based on action and leads, iteratively, to further action and the elimination of doubt. For pragmatism viewed in this manner, the emphasis is on experiences as the continual interactions of people's beliefs and their actions rather than the production of knowledge as an abstract philosophical concept. The purpose of this research was to produce new understandings that reflect on the considered needs of individuals and groups on issues that are of significance to them. Pragmatism is well suited to such research as it supports integrating methods within a single study and using research methodologies as discretionary tools designed to develop iterative understandings of the world (Onwuegbuzie & Leech, 2005).

Using an approach based on pragmatism is seen as most appropriate for cross-disciplinary research as it helps avoid paradigm polarisations and this allows researchers to employ design components that offer the best chance of answering their specific research question with an orientation to practical outcomes. A pragmatic approach "rejects the need to choose between a pair of extremes where research results are either completely specific to a particular context or an instance of some more generalized set of principles" (Morgan, 2007a). The pragmatic approach used for this research supports both the cross-disciplinary nature of this research and the orientation to providing practical solutions through deliberate engagement with appropriately identified approaches to evaluation.

This pragmatic orientation was also supported by the use of the theoretical premises of Developmental Evaluation to underpin the framework. Developmental Evaluation is seen as appropriate because it is well suited to dealing with flexible goals that are likely to arise in circumstances of innovation. Developmental Evaluation enables the measurement and consideration of progress against intended and unintended goals for projects incorporating the perspectives of multiple stakeholders. While Developmental Evaluation is not a completely unique theory of evaluation it helps avoid the delineations that might occur through a focus on either summative of formative evaluation. Developmental Evaluation is becoming increasingly used in circumstances of evaluation of programs of social innovation, for

example for social development projects funded by the Bill and Melinda Gates Foundation (Preskill & Beer, 2012a).

Research approach – Conceptual Modelling

The research for this study was conducted in two phases. The first phase was to develop the theoretical construct of the proposed framework. Since the proposed framework is a conceptual tool to facilitate further research it was appropriate to follow a Conceptual Modelling approach in developing the framework (Robinson, 2008a, 2008c, 2011). Conceptual Modelling is often used in business studies as a precursor to detailed simulation studies or situation analyses. The approach used in this study was similar in that the conceptual model was a precursor to the specific research. In this context Conceptual Modelling is the process of abstracting a model from a real or proposed system (Robinson, 2008b, p. 3). At this level of abstraction Conceptual Modelling may be seen as a compass providing initial orientation to establish the direction of the research to follow (Montevechi & Friend, 2012).

Using a Conceptual Modelling approach helps define messy problems in complex systems that rely heavily on human interaction. Conceptual Modelling does not prescribe a strict methodology but proposes a framework that provides the ability to structure a highly qualitative inquiry process and acquire specific knowledge while also assimilating different viewpoints on the same investigation system (Montevechi & Friend, 2012, p. 37). As a qualitative inquiry process Conceptual Modelling is iterative and repetitive, with the model being continually revised throughout the modelling study. The conceptual model is a simplified representation of the "real" system. All these factors make it appropriate for a Conceptual Modelling approach to guide the development of the framework used in this research.

Research approach – Expert Elicitation

The second phase of the research was the specific investigation of the conceptual framework. The methodology of Expert Elicitation (Meyer & Booker, 2001) was seen as most applicable to this research as it has the capacity to work across different disciplines, education and architecture in this case, operating in a pragmatic framework. Expert Elicitation helps clarify conceptual understandings, the use of language, and the procedures for evaluation in the field in a cross-disciplinary manner without being tied to a specific paradigm that could become exclusive to one of the groups of participants (Ayub, 2001; Cooke & Probst, 2006a; Hora, 2008; Meyer & Booker, 2001).

It should be noted that the research methodology of Expert Elicitation is used in the broader context of a Conceptual Modelling approach. The Conceptual Modelling approach gives coherence to the development of the overall structure of the framework (Robinson, 2008a). Expert Elicitation examines the validity of the content of the framework from the perspectives of the experts involved (Meyer & Booker, 2001).

Expert Elicitation involves the process of seeking reasoned judgements from experts on an issue where there is uncertainty about a specific outcome. Expert Elicitation provides a

systematic approach for the analysis and interpretation of the subjective judgements of the experts (Meyer & Booker, 2001). Expert Elicitation was seen as a most appropriate methodology for this research as it supports the qualitative analysis of data using nonparametric techniques for the purpose of model building, that is developing and refining the framework that is the basis of this study. Expert Elicitation has a history of being used successfully in multidisciplinary and cross-disciplinary studies.

Data for the research was collected through an on-line questionnaire distributed to identified experts. Experts were considered to be people with appropriate academic and professional experience relevant to the study. The initial set of experts approached for the research were identified in consultation with peak professional associations in architecture and education. The respondents were asked to identify their views of the significance of a range of factors related to the proposed framework for the evaluation of innovative education practices in innovative learning environments. The responses were provided on a Likert-type scale and as such provided ranking (ordinal) value. The purpose of the data analysis was to identify those factors that the respondents saw as most significant and least significant in relation to each other in the context of the framework. Nonparametric tests (scatter plots and univariate cluster analysis) were used to identify patterns in the data. These patterns were analysed with reference to the original framework to identify factors that respondents considered sufficiently significant or not sufficiently significant to include in the framework, and to identify issues that may cause re-consideration of the framework itself.

Data analysis and interpretation

The data were analysed with reference to the two guiding question for this study "What factors do architects and educators see as most significant in the relationship between innovative learning environments and innovative education practices?" and "What factors should be included in a framework for the evaluation of innovative education practices in innovative learning environments?"

Since the data was derived from a Likert type response set and only had ranking (ordinal) value it could not be used to ascribe quantitative comparisons of the factors. The purpose of the data analysis was to identify those factors that the respondents saw as most significant and least significant in relation to the declared elements of the framework for the evaluation of innovative education practices in innovative learning environments. The judgements for determining whether factors should be included or excluded in a revised framework are qualitative judgements based on a combination of considerations:

- Are there consistent patterns of responses from the respondents in identifying some factors as being significant and some as not significant? These patterns are represented through scatter plot charts as presented in Chapter 5.
- Are there clusters of sets of factors that indicate ways in which the factors might best be represented in the framework? Cluster analysis was done using univariate cluster analysis (UCA) using four-point clustering. Four-point clustering was considered appropriate in this situation as the two extreme clusters can indicate the sets of "clearly in" and "clearly out" factors and the two middle clusters identify the factors that need further consideration.

- Qualitative judgements were referenced to the original framework that was used to identify the factors and to develop the questionnaire. This identified factors that respondents considered sufficiently significant or not sufficiently significant to include in the framework. It also identified issues that may cause re-consideration of the framework itself.

Interpretation of the data aimed to support the pragmatic goal of helping people working in the field make the most appropriate judgements about the most significant factors in relation to the implementation of innovative education programs in innovative learning environments by bringing simplicity and coherence to a field that is often characterised as being "hyper-complex" (Blackmore et al., 2012).

The significance of this study

This study is significant in that the framework developed deliberately brings together the perspectives of architects and educators working in the field with an orientation to promoting pragmatic strategies for developing the evaluation approach most appropriate to the particular situational profile that is described.

The development and trialling of the framework sought to simplify a complex field. This was done by gathering feedback from experts in the field to identify the set of factors that are considered most significant for the declared purpose. The outcome is an interactive and adaptive framework that allows people wanting to undertake an evaluation of the effectiveness of implementing innovative education practices in innovative learning environments to develop a situational map of the factors of most importance to them, to identify the evaluation tool or technique most appropriate to their situation, and to monitor how they conduct the evaluation.

This research makes a significant original contribution to the field in three ways.

The research engaged with feedback from both educators and architects to gather perspectives of what were seen as the most significant issues relating to the evaluation of innovative education practices in innovative learning environments. This cross-disciplinary approach is most appropriate in addressing what is often described as a "polarised body of work" (Souter, Riddle, Sellers, & Keppell, 2011) that does not necessarily support the integration of perspectives that come from differing pedagogical and technological backgrounds.

The use of the research methodology of Expert Elicitation is significant in that it is possibly the first time it has been applied to a study of this sort. The general concept of Expert Elicitation is a process of gathering information and data from qualified individuals that can be interpreted to solve problems and make decisions in the designated field of investigation (Meyer & Booker, 2001). The use of Expert Elicitation is an efficient and effective way to gather data in relation to the research project, and also models the process of implementing the framework to facilitate evaluation activities. The use of Expert Elicitation had a direct pragmatic orientation. This approach was used to address the issue raised above so that the development of strategies in this field could help practitioners utilise them in real world circumstances.

The third significant contribution of this research is the development of the framework itself. The use of a framework that allows for individual situational analysis helps avoid the problem that evaluation in this field has often been too particular in focus and method and thus limited in its usefulness to practitioners (Imms et al., 2016, p. 19). The framework is not an evaluation tool in itself. It facilitates the identification of the most appropriate evaluation approach to be used in a particular situation and as such is a map of the terrain that logically links the evaluation with the identified factors relating to innovative education practices in innovative learning environments. The use of such a framework can bring consistency and coherence to evaluation conducted in the field, and thus provide for the development of a body of knowledge that can support more evidence-based judgements about actions in the field.

Conclusion

This research investigated an area characterised by many different strands of complexity. There is complexity in matching the aspirational goals of innovation in teaching and learning in new learning environments with the utilitarian need for value for money in expensive building projects. There is complexity in determining causal relationships between the provision of new learning environments and the implementation of new education practices. There is complexity in bringing together the multi-disciplinary perspectives of learning environment designers and education practitioners working on the implementation of innovative education programs in new learning environments. And there is complexity in establishing meaningful evaluation of projects that are innovative education practices in new learning environments.

This research used four complementary strategies to address these complexities. (1) At a meta level the research used a Conceptual Modelling approach to develop a conceptual framework to provide coherence in language and understandings for people from differing academic and professional backgrounds. (2) The details of the framework were based on a set of factors of significance that were identified through the pragmatic approach of gathering feedback from experts in the field. (3) The specific methodology of Expert Elicitation was used for the research as it best supports a pragmatic orientation of working with practitioners from multi-disciplinary backgrounds. (4) The research method of using an online questionnaire provided a tool that can help users develop a profile of issues considered most significant to their particular situation. This process helps practitioners identify their specific focus within the many complex interactions that could be occurring when implementing an innovative education project in an innovative learning environment. The research outcomes present a balanced integration of the perspectives of architects and educators working on projects of implementing innovative education practices in innovative learning environments.

Chapter 2: Literature Review

Introduction

This review of the literature supported the original premise for the research that there is a need for more sophisticated approaches to the evaluation of innovative education practices in innovative learning environments, especially approaches with a pragmatic orientation that support the combined perspectives of architects and educators.

There have been several substantial reviews of the literature in relation to the evaluation of learning environments conducted in recent years, especially in Australia and the United Kingdom. This chapter considers the existing body of work as a basis for establishing an overview of the field. The examination of the literature informs an understanding of the described scope of the field, the key issues identified within the field and the imperatives for further investigation. This review then identifies further relevant literature with a focus, in particular, on developing a framework for evaluation in a context of pragmatism. A synthesis of the literature establishes the specific context in which this research is situated and identifies the research approach to be undertaken.

The analysis of the literature presented in this review works through fours phases. In the first instance literature that engages with the broad nature of learning environments is examined. This body of literature is considered through three specific perspectives; that which focusses on the physical orientation of learning environments, that which focusses on the technological orientation of learning environments and that which focusses on the relational orientation of learning environments. Following this literature that focusses on frameworks that promote the evaluation of learning environments is examined. These frameworks are considered through the perspectives of those that have a technical performance orientation, those that have an education systems or education policy orientation, and those that have an education ecosystems orientation. Next there is a consideration of literature on evaluation that is considered significant to this research. The final phase of this literature review presents a definition of innovative learning environments derived from the literature.

It is appropriate to note that this literature review informs the Conceptual Modelling approach that comprises the first phase of research for this project, in particular, determining the objectives, inputs and content for the model to be developed.

The key literature reviews used as a foundation for this study are summarised in the table below.

Table 1: A summary of literature reviews used for literature identification for this research.

Author	Title	Date	Purpose/Focus	Number of items identified
(Higgins et al., 2005)	The Impact of School Environments: A literature review	2005	Commissioned by the Design Council (UK) to inform its Learning Environments Campaign	174
(Temple, 2007)	Learning spaces for the 21st century: A review of the literature	2007	Funded by the Higher Education Academy (UK) to inform future design of learning spaces	143

(Blackmore, Bateman, Loughlin, O'Mara, & Aranda, 2011; J, D, J, & J, 2011)	The connections between learning spaces and learning outcomes: people and learning places?	2011	Extensive annotated bibliography provided	147
(Cleveland & Fisher, 2013)	The evaluation of physical learning environments: a critical review of the literature	2013	Looks at methodologies and methods that have been used in the evaluation of physical learning environments	88
(Fraser, 2013)	Learning Environments and New Spaces Annotated Bibliography	2013	Builds on the annotated bibliography developed by Lee, Tan & Tout (2011)	105

The items identified in each of these reviews were a range of research papers, reports, books, electronic publications and conference proceedings. The most significant items were identified from this body of work and the review was extended by snowballing from selected authors to identify any more recent or related publications. A search or relevant databases (ERIC, SAGE, Google Scholar)) was undertaken using combinations of key terms – learning environments, education practices and evaluation - and combinations of synonyms of these terms. Since this research had an orientation to professional practice by architects and educators, items such as reports, policy papers and conference proceedings were considered as well as scholarly research. Ultimately, the items that are included in the bibliography of this thesis are those considered having most direct relevance to this research.

Context

The aim of this research was to develop a model in the form of a framework that would support the evaluation of the relationships between innovative learning environments and innovation in education practices. This framework should be able to be used by stakeholders involved in promoting innovative approaches to education in new learning environments to identify the most appropriate evaluation strategies to use to support the implementation of a project.

The rhetoric around education building programs can, at times, be seen to assume that building innovative 21st century learning environments will lead to innovation in education practices and subsequent improved 21st century learning outcomes for students. A study of the literature, however, suggests that a claim of a direct causal relationship between innovative learning environments and innovation in education practices is highly contestable and highly contested. Cleveland and Fisher (2013) claim that "approaches to evaluations that attempt to assess the effectiveness of physical learning environments in supporting pedagogical change are in their infancy and require further development" (p. 24).

While a number of evaluation tools and instruments have been developed around the world to evaluate learning environments these focus predominantly on the physical features of the space, rather than the relationships between space and desired education practices. In the *Spaces for Knowledge Generation Project* Souter, Riddle, Sellers and Keppell (2011) stated "our review of literature found a polarised body of work, one hand holding the theoretical and

the pedagogical and the other handling the technological and physical" (p. 5). Fraser (2013) claims that "the vast majority of the literature has been devoted to the design and evaluation of spaces" (p. 2) and that this has an orientation to being operational with a focus on "strategies, models, rules, steps, frameworks and principles to underpin the design of spaces". Temple (2007) concluded that "there is only limited literature that aims to relate space issues to teaching and learning" (2007), and Lee and Tan (2008) concluded from their review of the literature that "while there has been much attention to the design of learning spaces over recent years, evaluations of learning spaces have been limited in depth, rigour and theoretical grounding, and heavily reliant on informal or anecdotal evidence" (p. 3).

From an education perspective change is a complex process driven and mitigated by many interacting factors. Blackmore et al (2011) suggest that not only is it not possible to establish a linear relationship between learning spaces, their use, and student learning outcomes, there is a temporal dimension to the production, use and effect of learning spaces that needs to be considered.

The framework developed through this research is a significant contribution to the field in that it focusses on the relationships between learning environments and education practices, rather than treating either in isolation. The framework identifies a set of factors that architects and educators see as most significant in relation to implementing innovative education programs in innovative learning environments. The framework can be used to identify a profile of significant factors that help identify the most appropriate evaluation strategy to be used.

Considering a physical orientation of learning environments

A fundamental objective of this research was to help build a bridge between that "polarised body of work, one hand holding the theoretical and pedagogical and the other handling the technological and physical" referred to above. A first step was to describe the "technological and physical", that is, current understandings of innovation in learning environment design.

A survey of the literature on contemporary learning environment design revealed a number of issues. There has been an emerging pattern in the work of architects over the last two decades to engage more deliberately with the principles of teaching and learning when designing new learning environments. However, while there is growing consistency around the rhetoric relating to innovative learning environment design, there remains great diversity of opinion and practice around how innovation in design should be implemented and evaluated to support innovation in education practice.

The *Defining Spaces for Effective Learning* project of the Joint Information Systems Committee (JISC, 2006) brought a range of experts together to develop a consolidated analysis of building development issues. The final report highlighted that "educational building is an expensive long-term resource" and recommended the following principles for designing spaces for effective learning. Learning spaces should be:

- Flexible – to accommodate both current and evolving pedagogies
- Future-proofed – to allow space to be re-allocated and reconfigured
- Bold – to look beyond tried and tested technologies and pedagogies

- Creative – to energise and inspire learners and tutors
- Supportive – to develop the potential of all learners
- Enterprising – to make each space capable of supporting different purposes

The Programme on Educational Building (PEB) project of the OECD produced the *Compendium of Exemplary Educational Facilities* (OECD, 2006) using the following criteria to determine exemplary:

- Flexibility – transformable learning spaces, student centeredness, problem-based learning facilities
- Community needs – engagement with multiple stakeholders, catering for life-long learning, sharing facilities with families and others
- Safety and security – meeting design standards, financial accountability

These two projects represent a body of work that emerged from an architectural background seeking to make more explicit the connection between education principles and the physical learning environment. They show significant commitment to bringing key concepts and terminology of education into approaches to evaluation that had previously been framed by building and design concepts and had tended to focus on the mechanistic features of post occupancy evaluation.

Table 2: A summary of key terms used from an architectural perspective to describe features of innovative learning environments.

Flexible	Evolving pedagogies	Future-proofed	Re-allocated
Reconfigured	Bold	Creative	Supportive
Enterprising	Supporting different purposes	Student centred	Problem-based learning
Community needs	Multiple stakeholders	Life-long learning	Safety and security
Design standards	Financial accountability	Digital	Mobile
Interconnection	Virtual groups	Collaborative	Participatory
Global connections	Access to teachers	Breakout spaces	Cooperative learning
Access to ICT	Multimedia support	Quiet spaces	Multipurpose rooms
Student-teacher conferencing	Community in the school	Professional practice	Different approaches to learning
Educators	Resources	Learners	Content

The table above is a summary of the key terms used to describe features of innovative learning environments taken from the documents referred to in this section. They are representative of terms that come from the literature that derives from a background of

learning environment design. This table is not intended to represent any particular organisation or relationship amongst the terms It is presented merely as a list of the terms.

While the intention of the documents from bodies such as the Joint Information Systems Committee (JISC) and the Program on Educational Building (PEB) is to help designers be more oriented to educational issues there is still a strong orientation to the technical. The list is indicative of the features described in the documents referred to and, as such, provides a sound basis to help in the development of the framework proposed for this research. The significance of this list in helping inform the final framework developed through this research is discussed in the final findings presented in chapter 6 of this thesis.

Considering a technological orientation of learning environments

There is a body of literature that tends to advocate propositions for innovative learning environment design with an orientation to more active connection with digital learning in the design process. EDUCAUSE is one organisation that is representative of this approach. EDUCAUSE declares its mission is to "advance … education through the use of information technology" (Lomas & Oblinger, 2006, p. 2). The organisation's research and position papers advocate for innovative learning environments to encompass the following features:

- Digital – acknowledging that "technology" is a way of life for modern students
- Mobile – enabling the interconnection of multiple devices
- Independent – acknowledging the self-reliance of today's students
- Social – enabling students to work and collaborate in virtual social groups
- Participatory – recognising that students may participate with global connections

Brown (2006) emphasises the need to consider virtual space as a part of the learning environment.

> It is clear that the virtual space is taking its place alongside the classroom and other physical locations as a locus for learning. The result is that we are compelled to expand our concept of where learning occurs. Learning spaces encompass the full range of places in which learning occurs, from real to virtual, from classroom to chat room. (p. 22).

Similar themes are articulated through the *futurelab* project, "*what if…RE-IMAGINING LEARNING SPACES*" (Rudd, Gifford, Morrison, & Facer, 2006). This report proposes that new schools should be more than more comfortable warehouses. New design should "enable learning in a range of sites and in a range of different configurations of people and resources … enable flexible use of a range of different approaches to learning…and reflect an understanding of how people learn" (p. 6).

The Partnership for 21st Century Skills organisation in its white paper *21st Century Learning Environments* (2012) pictures these learning environments as

> the support systems that organize the condition in which humans learn best – systems that accommodate the unique learning needs of every learner and support the positive human relations needed for effective learning. Learning environments are structures

tools and communities that inspire students and educators to attain the knowledge and skills the 21st century demands of all of us (p. 11).

Another form of learning environment driven by recent developments in technology is immersive learning in 3D learning spaces. Virtual immersive spaces promote learning characterised by " sensory information-rich learning experiences that enable a much wider range of experiential learning and training – delivered to computer desktops, augmented reality spaces, digital installations, and mobile projective devices" (Hai-Jew, 2011).

Learning environments with such rich technological orientations will be radically different from traditional classrooms, and, indeed, may not even require the student to be at school to participate in such learning. This gives rise to the concept of a learning environment being any space where learning takes place. Such matters, however, are not addressed directly in this research. The specific concept of learning environment used in this research is presented later in this chapter.

Considering a relational orientation to learning environments

A series of investigations into innovative learning spaces in the Australian context have been conducted over the past decade, largely funded through the Office of Learning and Teaching (OLT) and the Australian Research Council (ARC) e.g. (Blackmore, Bateman, Loughlin, et al., 2011; Lee & Tan, 2008; Radcliffe, Wilson, Powell, & Tibbetts, 2008; Souter et al., 2011; Tibbetts, 2008; Wilson & Randall, 2010). A number of these studies have dealt with issues concerning the relationships between teaching and learning practices and the physical environment. Of these, some have dealt with the related issue of evaluating contemporary learning environments.

In discussing learning environment evaluation methodologies, Lee and Tan highlighted that "evaluations of learning spaces have been limited in depth, rigour and theoretical grounding and heavily reliant on informal or anecdotal evidence" (2008, p.3). Souter expressed concern that "although there is abundant, significant and expanding literature on teaching, learning and knowledge generation beliefs and practices, and an equally extensive strong body of work exploring physical and technological environments and systems for learning and teaching, published research intersecting both is uncommon and not well understood" (2011, p.5). There is considered to be a need to develop a better understanding of the connection between built learning environments and intended educational outcomes to determine whether the pedagogies, curriculum, assessment and organisational forms necessary to develop the capacities for the 21st century require different built environments and usage (Blackmore et al., 2012).

An issue that is emerging from this body of research is the realisation that the underlying paradigm has been one of a causal orientation, that is, assuming that a change in learning environment will ipso facto lead to a change in education practices (Boys, 2011). However, if learning spaces are not just seen as containers for human activity, but rather a backdrop against which action takes place then the focus for investigation and evaluation needs to be the relationships between the space and the occupants (Mulcahy, Cleveland, & Aberton, 2015a). Massey (1994) emphasises the importance of acknowledging the nature of space as a construct of social relations rather than an absolute independent dimension. She asserts that

such a way of conceptualizing space " implies the existence in the lived world of a simultaneous multiplicity of spaces: cross-cutting, intersecting, aligning with one another, or existing in relations of paradox and antagonism" (p. 3). Developing this concept further Massey (2005) proposes that our understanding of space should be based on three key propositions; space is always under construction, space is the product of interrelations and space is a sphere of multiple possibilities (p. 9).

This research addressed these issues of the relational orientation and dynamic nature of learning environments in two specific ways. The framework developed has deliberately declared time phases. These time phases acknowledge that development occurs over time and allow for the critical perspectives to change over time to recognise the socio-spatial dynamics that may occur. Evaluation of this ongoing dynamic of change in learning environments is supported through using a Developmental Evaluation approach that is described below.

Frameworks for learning environment evaluation

The purpose of this research was to develop a framework that facilitates the evaluation of innovative education programs in innovative learning environments. It was intended that the framework would incorporate the perspectives of both architects and educators working in the field and have a pragmatic orientation to supporting best fit evaluation for the situation as identified by the users themselves.

In pursuing the development of such a framework this researcher acknowledges that there are many frameworks or models available that relate to such a purpose. These frameworks and models, however, do not integrate all of the features being developed for this research. In this section I provide an analysis of some of the most significant frameworks and models that relate to the current research presented in the literature, identifying the strengths and shortcomings of these as they relate to this research. There are 19 frameworks considered, organised into three groupings: those with a technical performance orientation, those with an education systems or policy orientation and those with an education ecosystem orientation. The frameworks included in this analysis are those that are representative of the body of literature providing the most useful insights for the current research.

Frameworks with a technical performance orientation

Copa and Pease (1992) presented a model titled "New Designs for the Comprehensive High School" developed through a research project for the National Centre for Research in Vocational Education, Washington, DC. The model had learning oriented concepts at the forefront aimed at supporting the orientation of making high schools more suited to "preparing students for a changing world". The organising concepts included "learning outcomes", "learning processes", and "learning organisation". A concept for "learning environment" was also included. Learning environment was described as being engaging for students and leading naturally to cooperative experiential work. The learning environment should also make extensive use of learning technology. The model then describes a comprehensive consultative process for stakeholder engagement in a learning environment development project. The "Design Down" model becomes tightly prescriptive providing

design specifications to help interpret each point, with the model based on an archetype for a new facility of student families of 100 in student neighbourhoods of 400, within a total school community of 1600.

The model developed by Copa and Pease is significant in that it links learning principles with the learning environment and that there is an intention of innovation through the commitment to "preparing students for a changing world". The model was used as a frame of reference for an extensive research project looking at teaching and learning in Icelandic schools and provided a sound basis for educators and architects to collaborate with all stakeholders in the design process (Sigurdardottir & Hjartarson, 2011). In being comprehensive the model is quite complicated, and the Design Down process is very prescriptive. These are two issues that the framework developed for this research seeks to address through allowing users to identify a concise set of factors that are most significant to their situation, and then match an evaluation strategy most appropriate to the identified factors.

In a report commissioned by the Design Council (UK) Higgins et al (2005) presented a model that was intended to be the focus of a design-led approach to change. The model is significant in that coming from and architecture and design orientation it places learning at the centre as a "bridging element". The model is also intended to emphasise the dynamic relationship between all of the elements.
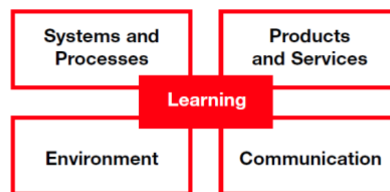
Figure 1: The model for project design themes presented by Higgins et al (2015).

The model is a conceptual organiser for a literature review and as such maps where the identified literature best sits. In doing this it identifies key features of all of the elements (except learning) with an orientation to environment which is broken into two sub-elements of the school built environment and physical environment in the classroom with eleven subsequent features. The commentary around the model suggests that the effectiveness of each element should be considered through the concepts of attainment, engagement, affect, attendance and well-being, but does not provide a theoretical framework for analysing and interpreting relationships and interactions.

The fundamental concept of the model of having learning at the centre with key elements around it is presented in much of the literature. This arrangement provides a useful organising tool and allows for comparison between models. However, the orientation to a design background by Higgins et al is indicated when they conclude that "It is extremely difficult to come to firm conclusions about the impact of learning environments because of the multi-faceted nature of environments…" (p. 6) without a matching statement about the multi-faceted nature of learning.

These insights are significant to this research as they offer another perspective on the challenges of bringing the complex areas of learning environments and learning innovation together. One insight from the Higgins report was particularly significant in shaping the development of the framework for this research in the statement "in a changing world no design solution will last forever" (p. 3). This emphasis on change occurring over time is taken up in further literature and addressed in the framework for this research through the phases of the framework.

Preiser and Nasar (2008) suggest that their "consumer-oriented approach is part of a new democratic paradigm embodying autonomy, self-organisation, ecology, sustainability, adaptation and continuous improvement". While their approach has a design and project management orientation it is a meaningful attempt to show how post-occupancy evaluation can be more diagnostic and developmental with reference to the facility users. The paper promotes a more holistic approach to evaluation than previous POE approaches with an emphasis on including the perspectives of users as consumers in the evaluation. Whilst the declared purpose of such approaches to evaluation is to inform future projects, it is showing an awareness of the socio-spatial nature of learning environments and the importance of engaging with this in the design process.

A project that gave realisation to the intentions presented in the three papers just reviewed was the Evaluating Quality in Educational Spaces (EQES) project from the Centre for Effective Learning Environments of the OECD (CELE, 2009). While the project methodology for EQES derives from post-occupancy evaluation and facility performance evaluations it seeks to assist education authorities and school leaders in optimising their use of learning environments, rather than having a narrow focus on project development cycles for designers. The EQES project recognises the importance of engaging stakeholders in the evaluation process but acknowledges the difficulty in defining quality indicators for evaluation in the context of education systems. The EQES approach is to present a framework that allows individual users to define quality in relation to their own contextual priorities. The EQES framework engages with the inter-relationship between the broad priority issues of a user group and issues of quality in educational facilities over a facility's life cycle.

These two concepts of enabling users to determine their own issues of greatest significance and addressing inter-relationships over the life cycle of a facility are incorporated as key concepts into the framework developed for this research.

Frameworks with an education systems or policy orientation

One of the problems in addressing issues of innovation in learning environments and education practices in schools is the fact that innovation in education is massively complex. Blackmore et al use the term "hyper-complexity" (2011, p. 4). A google search of the terms "education innovation" and "education change" will bring up more than 3 billion items. There is a challenge, therefore in finding the appropriate focus for the connection between innovation in learning environments and innovation in education practices.

The items reviewed in this section are identified because they help look at the relationship between education systems and/or policies and innovative learning environments, and look at

the purpose of this relationship, that is the intentional role of an innovative learning environment in facilitating an innovation in education practice. There are only eight items reviewed in this section, and, as such, this is a highly selective sample of literature in the field but is considered to be representative of the field in the manner that it informs the development of the framework for this research.

The work of Owens and Valesky (2015) has a focus on organisational behaviour and leadership for school reform. It is similar to many works in the field in addressing the educational concepts of school organisation, school culture and social milieu. A significant aspect of this work is that it also includes the concept of school ecology, and includes the concrete features of buildings and facilities, and technology in this. The purpose of this model is to offer a framework of organisational culture and organisational climate that can be used by school leaders to manage school reform projects. However, although the concept of ecology is a part of the Owens and Valesky model, it is not elaborated at all in the text of the book and is not addressed as a part of the dynamic of the model.

Gislason (2010) used the Owens and Valesky model to frame field research in the form of three case studies of innovative plan schools in Minnesota. Gislason concluded that the model is useful in highlighting the linkage between the key concepts (ecology, organisation, milieu, culture) but that there is a need for the building design aspect of ecology to be viewed as a more integral part of the network of elements. The fact that the Owens and Valesky book is now in its 11th edition but that the role of building design in school reform has not been further articulated demonstrates the extent of the challenge in addressing this issue. Building design and the learning environment are often seen as passive or background issues in school reform, rather than having a role in shaping and directing that reform.

The EDUCAUSE project in the US deliberately advocates developing technology rich learning environments to promote innovation in education. Johnson and Lomas propose a Conceive/Design/Implement/Operate (CDIO) cycle in designing and implementing new learning spaces (C Johnson & C Lomas, 2005). This cycle should incorporate addressing the ongoing relationship between six key features: (1) identifying the institutional context, (2) specifying learning principles, (3) defining learning activities, (4) developing clear design principles, (5) creating a set of performance requirements and (6) determining a methodology for assessing success. The nature of a CDIO cycle and the key features presented by Johnson and Lomas is represented in similar forms in much subsequent literature and is a key concept for establishing the framework developed for this research (Crawley, 2001).

Johnson and Lomas also make reference to the relative life cycles of elements of a project in designing and implementing new learning spaces. A key point they make is that learning theories have a life cycle, along with buildings and technology and the interactions of these life cycles places ever-changing demands on the learning space. The issue of the life cycle of learning theories is rarely discussed in the literature around innovative learning environments. This research project addresses the issue indirectly by allowing user groups to identify whether or not it is a significant factor in their own profile of their project.

The Pedagogy/Space/Technology (PST) model developed by Radcliff et. al. (2008) presents a life cycle concept with two stages: conception and design, and implementation and operation. While this seems to be essentially a contraction of the CDIO model presented by Johnson and Lomas it is part of a continuing pattern in the literature to incorporate a life cycle concept into

the relationship between learning environments and education activities. Reushle added people to the PST model emphasising the role of stakeholders in the process, with stakeholders being described as students, teachers, technicians and others (Keppell, Souter, & Riddle, 2012).

The PST model is different from others in that it does not detail specific elements within each component of the model. Instead, it provides guiding questions that could help users expand each component in a manner appropriate to their situation. The guiding questions include "What types of learning and teaching are we trying to foster?", "What aspects of the design of the space …will foster these modes of learning?", and "What technology will be deployed to complement the space design in fostering the desired learning and teaching?" (p. 15). The questioning approach facilitates the user group in interrogating their own situation rather than imposing a pre-determined model on them. This concept of enabling users to develop a profile appropriate to their specific situation is a core concept of the framework developed for this research.

The New Media Consortium (NMC) is a project that advocates for the use of new media and new technologies in education institutions. The NMC uses a framework derived from the "Upscaling Creative Classrooms in Europe" project to provide ongoing analysis and evaluation of new media and new technology projects (L. Johnson, Adams Becker, Estrada, & Freeman, 2015a). The framework has eight organising concepts with infrastructure as one. Infrastructure is described as having two elements: ICT infrastructure and physical space. Overall there are 28 elements across the eight organising concepts in the framework that is intended to see learning environments as live ecosystems that evolve over time, changing over time in tune with the context and culture in which they exist. The framework highlights the complexities that arise when working with an extensive and dynamic model, but also shows that the production of annual reports consistently based on the framework can build a body of data that provides for ongoing qualitative analysis.

The framework developed for this research aimed to be more concise than the NMC framework but recognised that a range of factors need to be addressed and included many of the concepts and elements of the NMC model in the initial version of the research framework. The process of research through Expert Elicitation then identified which of these concepts and elements were considered sufficiently significant for further inclusion.

The Partnership for 21st Century Learning promotes a project called "Building Your Roadmap to 21st Century Learning Environments" (2016). The project aims to promote its declared vision of 21st century learning with an orientation to technology rich learning. It addresses organising concepts and key features in a manner similar to the NMC project. The 30 key features presented were also used to inform the set of factors presented in the framework for this research. The roadmap approach of the Partnerships for 21st Century learning project emphasises the uniqueness of individual situations and provides a tool to help planning at school and district level in a form of situational analysis. The concept of enabling users to map their own terrain within a broader context is a key concept underpinning the development of the framework for this research.

Frameworks with an education ecosystems orientation

The "Innovative Learning Environments" report from the Centre for Educational Research and Innovation (CERI) of OECD describes the learning environment as a holistic ecosystem that functions over time and in context (Centre for Educational Research and Innovation, 2013). Using this approach "learning environment" becomes a framing concept for situating educational activity. Educational activity takes place in a dynamic ecosystem where all elements are in constant interaction that can be generating outcomes not previously anticipated. This is significantly different from the models investigated previously where learning environment is seen as a static element in considering educational activity. The CERI project developed this model of learning environment through pragmatic analysis of 125 case studies, rather than as a theoretical premise. The model gives primacy to learning environment in describing and analysing educational activity. The model does not list definitive features of the elements of the framework but presents the framework on several occasions to highlight the location and relationship of a range of elements that are addressed.

Such a conceptualisation is significant in shaping the framework developed for this research. Using learning environment as a framing concept helps ensure focus on core purpose. The purpose is to evaluate aspects of the relationship between innovative learning environments and innovative education practices.

Blackmore et al make several mentions of the complexity of the relationships between learning environments and the practices of teaching and learning. They suggested 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)" (2011, p. 5). The literature, as they viewed it, had a focus on the tangibles connecting learning spaces and learning outcomes rather than the intangibles of how teachers and students respond to and use space in ways that improve learning. The key feature they proposed to address this issue is the temporal dimension of their framework.

The framework presented by Blackmore et al (2011) is in the form of a matrix where the features (Practitioners, Learners, Spaces) are each considered across the four declared time phases (Design, Transition, Consolidation, Sustainability). This framework has a deliberate relational orientation that facilitates the evaluation of the inter-connected development of learning environments and teaching and learning over time.

The framework presented by Blackmore et al is significant in informing the current research in that it specifically identifies perceived gaps in the examined research in relation to each of the phases. It is the aim of this research to provide a framework that enables users to identify the significance of such issues in relation to their own context and to determine how significant these issues are to their particular project.

Key issues identified for this research from the work of Blackmore at al are as follows:

- Design phase – limited recognition of the significance of the context of school.
- Transition phase – little empirical research that considers how teachers and students as well as communities create new relationships and organisational structures in the use of learning spaces.

- Consolidation phase – little research on the role of mediating variables such as teacher professional development in influencing how space is used.
- Sustainability phase – an inability of participants from different backgrounds (architecture and education) to communicate with each other and develop common understandings.

Lee and Tan (2008) proposed the phases of Design / Build / Occupation as the organising concepts for their model. These concepts should drive a monitoring and evaluation process in a continuous manner similar to action research. The model was used in a series of trial evaluations. The three evaluations presented are quite disparate and demonstrate how difficult it can be to keep evaluation aligned with the initial planning goals and implementation processes. Overall, the model and strategies for implementation presented by Lee and Tan reinforce the concepts of an education ecosystem that acknowledges that any building and implementation project in education will be influenced by a range of anticipated and unanticipated factors over time. Their proposal for a cyclic revisiting of the Design / Build / Occupation phases has many similarities to the CDIO cycle of Johnson and Lomas and the four-phase cycle of Blackmore.

The International Society for Technology in Education (ISTE) presents a model that specifically advocates visionary leadership to help achieve best outcomes for innovation in learning environments and learning outcomes (Basye, Grant, Hausman, & Johnston, 2015). The declared purpose of ISTE is to promote engagement in technology rich "active learning". They suggest that this will best be achieved by having visionary leadership drive digital age learning culture to produce digital citizenship. Their model for implementation is a continuous cycle similar to the other cyclic models with an orientation to an education ecosystem. While the current research did not take an advocacy position on issues such as technology rich learning environments (that is determined in individual situations) it did acknowledge the need for consideration of the role of leadership in planning and implementing innovative education projects in innovative learning environments.

Another model that is developed on the basis of learning environments as ecosystems is the *Innovative Learning Environments (ILE) Guide* presented by the Ministry of Education, New Zealand (2017). The purpose of the guide is a support for school leaders, teachers and school communities in developing and implementing innovative learning environments. The model presented has six organising concepts: understanding pedagogy, using a collaborative process, providing professional learning, designing flexible spaces, involving students in planning, involving parents and whanau in planning. While the model is comprehensive it highlights the problems of complexity associated with such comprehensiveness. Each organising concept (6) is broken down into key ideas (26 in all), and each key idea has a series of key resource documents (121 in all). How to make useful meaning of such a volume of ideas and documentation is a critical issue addressed through the framework and questionnaire developed for this research.

Issues in evaluation

The evaluation of the effectiveness of innovative learning environments has become an important issue with the recent development of new education building in many developed

countries that is intended to support contemporary approaches to teaching and learning (OECD, 2009). The trend towards creating technology rich facilities with a range of more flexible space configurations can be expensive and this trend towards new spaces is usually linked with a rhetoric of achieving innovative outcomes in teaching and learning (JISC, 2006). It is, thus, reasonable to ask how well new building projects are performing with regard to achieving their intended outcomes.

Bligh and Pearshouse (2009) identify a range of interconnected reasons for conducting learning spaces evaluations. The need for a better understanding of learning-space relations is important in its own right. Evaluations should also be able to represent such understandings to funders and other stakeholders that convince them of the efficacy of the project, and to be useful in future planning. This should also help design solutions to be implemented in other locations to improve the use of current and future spaces.

A consideration of how evaluation can be conducted (methodology and methods) needs to be situated in the broader context of evaluation theory. Alkin's (1990) description of the nature and breadth of the field of evaluation theory through the "Evaluation Theory Tree" helps in understanding the scope, particular foci and inter-relationships of theories and approaches in evaluation.

Carden and Alkin (2012) suggest that researchers in the field that have a methods orientation generally use the term theory as somewhat synonymous with approaches and models. Thus there is not a body of empirical or descriptive theory, but rather a tendency by writers in the field to describe their prescription of how they believed an evaluation should be conducted in a manner that Carden and Alkin describe as "prescriptive theories" (p. 103).

A second orientation is a focus on valuing. This derives largely from the work of Scriven who asserts "evaluation is not evaluation without valuing" (in Carden & Alkin, 2012, p. 105). The key work of evaluation is making value judgement about the object under study, but there is discussion in this field as to whether, and how, evaluation can be objective or subjective. The objectivists contend that it is the role of the evaluator to do the evaluating whilst the subjectivists claim that the valuing judgement must be made within the context of understanding of the "subjective meaningfulness".

The third branch of Alkin's tree focusses on the use of evaluation. This has an orientation toward connections between evaluation and decision making. The usefulness of evaluation is seen as ranging from a specific focus on applying by those directly empowered to use the evaluation information to engage with a broader user audience that supports capacity building within the organization.

Carden and Alkin emphasise that the three tree branches are not meant to be viewed as independent from one another, but rather should also indicate relationships to each other. The taxonomy of the tree helps identify particular orientations and the primary emphasis of the evaluation rather than any sense of theoretical purity. In practice evaluation should be flexible and adaptive whilst still maintaining accountability to the predominant theory that informs it.

The evaluation approach taken in this research project was aligned with the use branch of Alkin's tree and based most closely on the theory of Developmental Evaluation presented by Preskill that argues for the need to move beyond traditional concepts of formative and

summative evaluation if the evaluation is to be useful in a context of innovation (Preskill & Beer, 2012b).

The framework for this research addressed a socio-spatial concept of relationships between learning environments and education practices as well as a traditional linear/causal concept of relationships. In this context there are evaluation relationships that are dynamic and unpredictable with outcomes that are emergent and innovative. In such situations the past does not necessarily predict the future and finding new solutions to complex problems does not have the luxury of a clear and proven path to follow (Preskill & Beer, 2012b, p. 3).

Preskill and Beer argue that the traditional approaches of formative and summative evaluation are typified the following set of assumptions and principles:

- The focus is primarily on model testing, with a clearly hypothesized chain of cause and effect.
- It is important to measure success against predetermined goals.
- The evaluator should be positioned as an external, independent, and objective observer.
- Evaluations should be based on predictive logic models.
- Evaluations should follow a predetermined plan.
- Evaluation's purpose is to refine the program or model and then render definitive judgements of success or failure.

However, evaluation of a socio-spatial concept of relationships needs to acknowledge that it is not an evaluation of a simple change program with a known set of elements and certainty around the nature of the relationships between these elements. While there might be a sense of the broad goals of implementing a program of education innovation in an innovative learning environment the path to achieving such may not be clear and there will be many factors that mitigate what will work, where, under what conditions, how and with whom. Developmental Evaluation is seen as an approach best suited to such situations.

Michael Quinn Patton, a key figure in conceptualising Developmental Evaluation, describes Developmental Evaluation in the following way:

> Developmental evaluation informs and supports innovative and adaptive development in complex dynamic environments. DE brings to innovation and adaptation the process of asking evaluative questions, applying evaluation logic, and gathering and reporting evaluative data to support project, program, product, and/or organizational development with timely feedback. (Patton, 2012, p. 3).

Preskill and Beer describe five key characteristics of Developmental Evaluation that distinguish it from other evaluation approaches. The focus of the evaluation is on a dynamic or innovative situation, there is an intentionality of learning throughout the evaluation process, the evaluation design has an emergent and responsive nature, the role of the evaluator is as a strategic learning partner to the clients, and there is an emphasis on using a systems lens for collecting and analysing data and generating insights.

At this level of analysis Developmental Evaluation does not prescribe a particular research method. What it indicates is that there will most probably be a mixed or multi-methods

approach with the selection and utilization of the methods shaped by an overriding focus on the usefulness of the evaluation in a situation of innovation.

A Developmental Evaluation approach was considered appropriate to this research as it supports the socio-spatial dynamic concept of learning environments that underpins the framework and provides a meaningful alternative to the summative evaluation orientation that POE traditionally presents in the field.

Defining innovative learning environments

In the literature around evaluating learning environments there are very few instances where the concept of learning environment is specifically defined. Sometimes it is "the building" that is evaluated (JISC, 2006), sometimes the reference is to learning space and sometimes to learning environment. In some instances the terms learning space and learning environment are seen as interchangeable, but in other cases there are attempts to give specific definitions to one or both of these terms.

Boddington and Boys (2011) highlight the point that "of critical concern is the ambiguity of space as a category". They point out that even in chapters written for the one book "there is considerable slippage in the use of the terms between the conceptual, the physical and the metaphorical: between individual, community and public space: and between personal and imaginary space, institutional spaces (whether digital or physical), and the public realm"(p. 8).

Blackmore et al (2011) use the term "learning spaces" in the title of their paper but present a definition for "school environment" to frame their analysis. Cleveland and Fisher (2012) use the term "physical learning environments" in the title of their paper and go on to use the terms "educational facility", "schools", "building", "learning environment" and "educational spaces" interchangeably throughout the paper. There are both subtle and significant differences between these terms and how they are used and moving between concepts can confuse the purpose and efficacy of evaluation.

The concept of learning environments being educational facilities, or vice versa, can be seen to arise from the body of work around post-occupancy evaluation (POE) and the development of that work over the last three decades (JISC, 2006; OECD, 2006). Originally there was not seen to be a need to define the concept of learning environment as it was quite simply that which was built. Subsequent developments in digital connectivity and virtual learning opportunities, however, mean that the learning environment is more recently seen as much more than the physical learning space of classroom (Learning, 2012; Lomas & Oblinger, 2006).

The Partnership for 21st Century Skills organisation in its white paper *21st Century Learning Environments* pictures these learning environments as "the support systems that organize the condition in which humans learn best – systems that accommodate the unique learning needs of every learner and support the positive human relations needed for effective learning. Learning environments are structures tools and communities that inspire students and educators to attain the knowledge and skills the 21st century demands of all of us" (2012, p. 6).

The report *Innovative Learning Environments* (*ILE*) from the Centre for Educational Research and Innovation (CERI) of OECD used a case study approach (125 examples from 20 countries) to develop a model of "learning environment" and to provide examples of innovation in learning environments (Centre for Educational Research and Innovation, 2013). The model is composed of four elements: learners, educators, content and resources (p. 11).
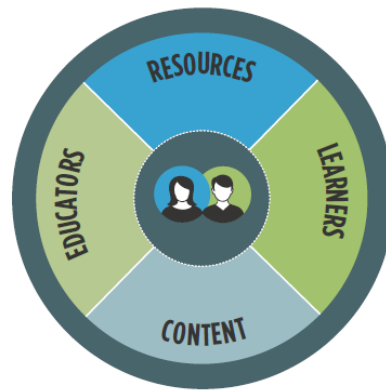
Figure 2: Model of learning environment from Innovative Learning Environments, CERI (2013, p.23).

In presenting this interpretation of learning environment the ILE report describes a learning environment as "an organic, holistic concept that embraces the learning taking place as well as the setting; an eco-system of learning that includes the activity and outcomes of learning" (p. 22).

The *Innovative Learning Environments* report opens with the statement "Innovation is a key element of today's societies and economies, and that includes how we learn" (2013, p. 11). Blackmore et. al. noted that "The notion of innovation is itself problematic in education" (2012, p. 10). They highlighted that innovation occurs in schools in the same environment that has to simultaneously provide services and maintain the smooth running of everyday practices. With the need for schools to operate as systems that provide stability, predictability and continuity, it is difficult for them to make fundamental transformations of structures and operations. Given this context, the CERI report presents a conservative definition of innovation in its project cases. The authors define educational innovation as "an intentional departure from the traditional approach of the large body of general or vocational education in its own context – i.e. it is deliberately innovative" (p. 25).

Having considered the 147 items in their extensive literature review Blackmore et al presented their working definition of learning spaces as "the school environment includes social, cultural, temporal, physical (built and natural) aspects, as well as real and virtual environments" (2011, p. 4).

In such a context it is important to determine where the focus of this study will be - somewhere between the finitely bounded physical confines of a classroom and the unbounded experience of global connectivity - to be consistent in both concept and terminology to be used in this research project.

The working definition of innovative learning environments used for this project is derived from both the CERI and Blackmore et al definitions. The environments investigated were school focussed and included those elements defined by Blackmore et al. For innovative learning environments there is also a significant element on intentionality, i.e. the declared intention to innovate or change in some manner.

Definition of learning environment

The definition of innovative learning environments used for this project was:

Innovative learning environments are those elements of school environments including physical, social, cultural and temporal aspects, as well as real and virtual environments, in which there is an intention to implement innovative approaches to teaching and learning.

It is important to note that while this definition is contextual and self-referenced with an orientation to individual educational organisations or settings it also helps build an organisational model of educational innovation that is transferable. A concept and framework with transferability is needed to build a model that can be applied repeatedly across a range of contexts and situations and can thus develop the research qualities of validity and rigour.

This research used a pragmatic approach to address the issues raised in the approaches to determining learning environments. While the research was addressing the relationship between innovative learning environments and innovative approaches to education it did not prescribe a technology oriented innovative learning context. The pragmatic approach allows users in a particular situation to determine the key features of the learning environment of most significance to them. This pragmatic approach has an orientation to evaluation that best suits the context and purposes of the users, rather than having to fit a particular definition of learning environment and specified evaluation paradigm.

A comment on innovation

The work of the Innovation Unit in the United Kingdom is attempting to address the issue of the nature of innovation in schools. Hannon, Patton and Temperley (2011) highlight the need to differentiate between an innovation agenda and an improvement agenda in making educational change. They advance the argument that if the focus is on improving the current model of schooling this will never by itself generate innovation that leads to different educational provisions and educational outcomes. They argue that innovation requires deliberate engagement with changing at least one element of the current educational provision.

While the framework in Figure 2 suggests that innovation in learning outcomes occurs when there is engagement with innovation in both learning environment design and education practice it does not mean to imply that innovation only occurs through a "leap of faith" into the bottom right quadrant. The nature of innovation is more nuanced than that. Johnson (2010) makes a case for rejecting the "eureka" moment portrayal of innovation and suggests that innovation is more likely to be "slow hunch" development through connections of ideas to generate new products or new practices. Building on this concept it is appropriate to consider innovation in education as an ongoing journey, rather than the achievement of a

particular outcome. The arrows in the centre of the framework below suggest such a dynamic. What the framework does is help map the journey of innovation. A school or learning institution could be working across all four quadrants of the framework at any point in time. At one particular moment the innovation could have a focus on the physical learning environment such as the establishment of a new outdoor learning area. At another time the innovation could have a focus on innovative pedagogies such as the implementation of problem-based learning methodologies. Action on either of these innovations could be expected to lead to improved learning outcomes. The purposeful combination of action on both of these areas could provide the opportunity for truly innovative outcomes in teaching and learning in the manner defined by Hannon, Patton and Temperley.

This concept of innovation relates to the definition of learning environments presented previously. It has a pragmatic orientation that allows practitioners to determine the exact nature of innovation as it is most appropriate to their circumstances.
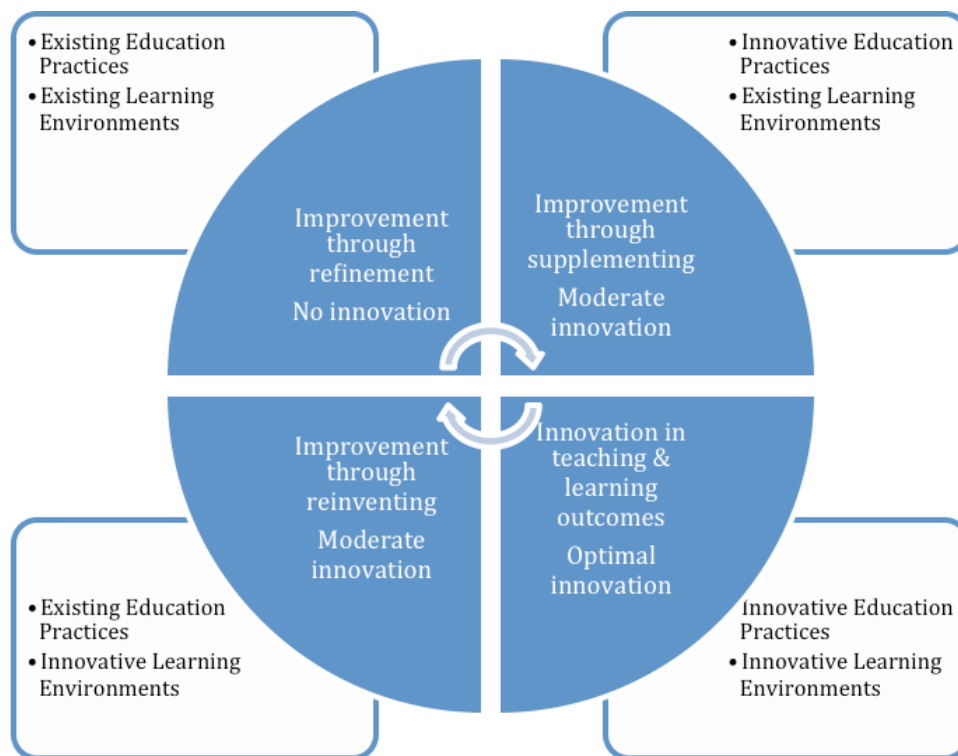
Figure 3: A framework for analysing the relationship between innovative learning environments, innovative educational practices and innovative outcomes in education (adapted from Hannon, Patton & Temperley, 2011).

Conclusion

The literature included for analysis here is a synthesis of key literature in the field intended to describe the specific context in which this research is situated and the specific issues to be investigated. The items identified include a range of research papers, reports, books, electronic publications and conference proceedings being those considered to have the most direct relevance to this research. The literature examined looked beyond the simple

assumption that building 21st century learning environments would automatically lead to innovation in education practice. While there has been a significant effort by those involved in the design of learning spaces to engage more deliberately with the principles of teaching and learning when designing new learning environments there remains great diversity of opinion and practice around how innovation in design should be implemented and evaluated to support innovation in education practice.

Recent literature examines the complex relationship between learning environments and changes in teaching and learning. An education ecosystems orientation acknowledges that development occurs over time and evaluation must recognise the socio-spatial dynamics that may occur through people's behaviours in occupying space. Evaluation of this ongoing dynamic of change is considered to be best supported through using a Developmental Evaluation approach.

The purpose of this research was to develop a framework that facilitates the evaluation of innovative education in innovative learning environments. The framework incorporates the perspectives of both educators and architects working in the field and has a pragmatic orientation to support the most appropriate evaluation for the situation as identified by the users themselves. Given this, the literature examined in this review had a focus on frameworks and models with such an orientation presented in previous research, literature studies and policy papers. These frameworks and models, however, do not integrate all of the features being considered for this research in one single coherent study. Analysis of the various frameworks identified strengths and shortcomings as they relate to this research. Key issues were identified through a technical performance orientation, an education systems and policy orientation, and education ecosystems orientation.

The over-riding concern is of the extreme complexity of the field. This research provides a strategy for dealing with this complexity presented in the following two chapters. In the first instance the research uses a Conceptual Modelling approach to propose a new framework to bring conceptual coherence and organisation to the issues identified through this literature review to support the key purpose of facilitating the evaluation of innovative education practices in innovative learning environments (Chapter 3). Following this the research uses a methodology of Expert Elicitation to refine the framework and determine ways in which it can be used to support approaches to evaluation appropriate to specific situations (Chapter 4)

Chapter 3: A Theoretical Framework for Evaluation

Introduction

The need for a framework that could help provide a situated connection between the design of innovative learning environments, the education use of innovative learning environments and evaluation of the effectiveness of innovative learning environments in promoting and sustaining innovative education practices was identified in the E21LE ARC project. The development of this framework relates to the overarching research question of that project: "How can we determine which learning environments best support 21_{st} century pedagogies?". The purpose of the development of a framework was to map the terrain so practitioners can best identify their particular situation and circumstances for evaluation of the complex field of relationships between learning environments, teaching and learning practices and learning outcomes. The approach does not develop or identify a specific evaluation tool, technique or approach, but helps users identify what tool, technique or approach to evaluation from a known suite in the field would be most appropriate to their purposes.

The conceptual organisation and details of content for the framework were developed from a literature review of the field. The purpose of the literature review was to gain an overview of the field and an understanding of the specific issues that were being reported as significant in the field. The methodology used for developing the proposed framework from the literature review was based on a Conceptual Modelling approach.

A Conceptual Modelling approach

Since the proposed framework for evaluation is a conceptual tool to facilitate further research an approach based on Conceptual Modelling was used in developing the framework. Conceptual Modelling is often used in business studies as a precursor to detailed simulation studies or situation analyses. The approach being used here is similar in that the conceptual model is a precursor to the specific research. In this context Conceptual Modelling is the process of abstracting a model from a real or proposed system (Robinson, 2008b, p. 3). At such a level of abstraction Conceptual Modelling may be seen as a compass providing initial orientation to establish the direction of the research to follow (Montevechi & Friend, 2012). Using a Conceptual Modelling approach helps define messy problems in complex systems that rely heavily on human interaction. Conceptual Modelling does not prescribe a strict methodology but proposes a framework that provides the ability to structure a highly qualitative inquiry process and acquire specific knowledge while also assimilating different viewpoints on the same investigation system (Montevechi & Friend, 2012, p. 37). As a qualitative inquiry process Conceptual Modelling is iterative and repetitive, with the model being continually revised throughout the modelling study. The conceptual model is a simplified representation of the "real" system. All these factors make it appropriate for a Conceptual Modelling approach to guide the development of the framework to be used in this research.

Guidelines for Conceptual Modelling

This research followed the guidelines for Conceptual Modelling presented by Robinson where the model has four main components: objectives, inputs, content and outputs (2008b, p. 13). The objectives of the model were explored in the introduction and literature review of this thesis and are declared in the previous chapter. The outputs of the model are the development of the research questionnaire and the iterative development of the model and questionnaire. These matters are developed in the subsequent chapters of this thesis. This chapter focusses on the development of the inputs and the content of the model. The inputs of the model are those elements that can be altered to provide an improvement in or better understanding of the problem situation. In this case they are the interrelated features that give the unique structure to the proposed framework – the phases, foci and perspectives. The model content is those components that describe and define the scope of the model and the level of detail. In the proposed framework the content is given through the declared factors for evaluation. The Conceptual Modelling approach describes a process that can be used to provide rigour and validity to the development of an abstract model but does not provide criteria that determine the value of what should be included in the model. Decisions about the exact nature of the model, specifically the inputs and content, are made in the context of the broad purpose of the model as described through the declared objectives and intended outputs.

Developing the framework

The explicit description of the framework of factors for learning environment evaluation relates directly to the inputs and content components of the Conceptual Modelling approach. The phases, foci and perspectives of the framework described here are considered the inputs of the conceptual model as they shape the nature of the detailed content (the factors for evaluation) that follow.

Four key concepts were derived from the literature review that formed the basis of the proposed framework:

1. The framework needs to be cross-disciplinary in that it can combine the perspectives of academics and practitioners in the fields of architecture and education (Cleveland & Fisher, 2013; Lee & Tan, 2008; Souter et al., 2011; Temple, 2007).
2. The framework should recognise that evaluation needs to be carried out over a period of time that acknowledges the ongoing interactive developments that occur between space and its users (Blackmore, Bateman, Loughlin, et al., 2011; Chris Johnson & Cyprien Lomas, 2005; Mulcahy et al., 2015a; Radcliffe et al., 2008).
3. The framework needs to help organise the multitude of complex issues that interact in this field in a manner that allows users to make appropriate sense of their particular situation (Blackmore et al., 2012; Boys, 2011; JISC, 2006; OECD, 2006).
4. The framework needs to help identify approaches to evaluation that will be most appropriate to the particular situation identified by the users (Carden & Alkin, 2012; Patton, 2012; Pearshouse et al., 2009; Preskill & Beer, 2012b).

The framework thus developed has the following elements:

- Phases – Four phases in the cycle of implementation and evaluation (Design / Transition / Consolidation / Re-appraisal).
- Foci – Two foci for framing consideration of issues (Learning Environment Focus / Education Practice Focus).
- Perspectives – Key perspectives declared within each focus at each phase of the evaluation cycle. The perspectives represent the orientations of Learning Environment Designer / Education Leader / Education Practitioner / Education Consumer.
- Factors – These are the issues or the specific points for consideration flowing from each perspective at each phase of the evaluation cycle. There are 18 factors presented at each Phase of the framework for a total of 72 factors for the entire model.

A diagrammatic overview of the framework is presented below.
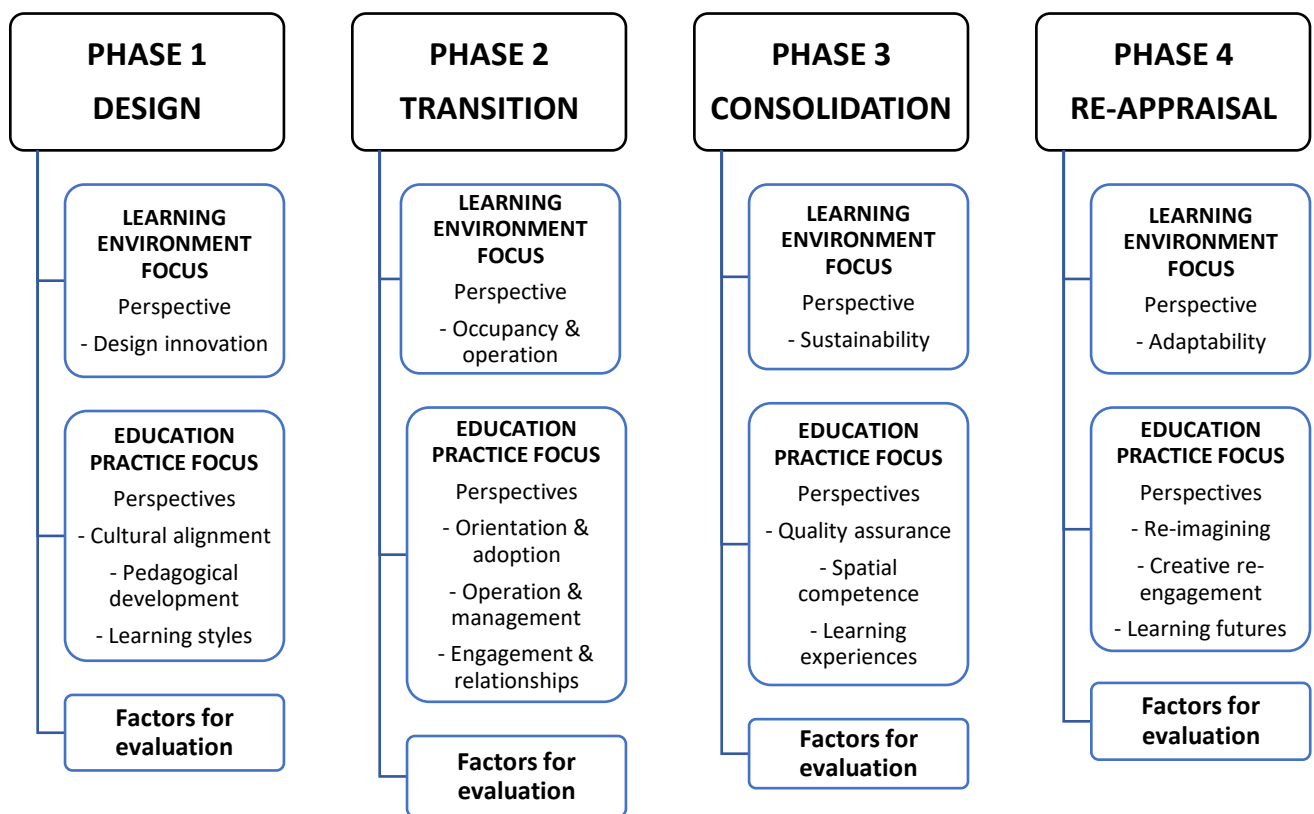
Figure 4: An overview of the framework of factors for learning environment evaluation.

The framework is not intended to provide a definitive statement of the factors to be addressed. Indeed, the factors are not listed in the framework at this stage. The framework is intended to provide conceptual coherence and guiding principles for identifying the list of factors. The rationale for the presentation of the framework in this manner is presented in the following four sections that look at the phases, the foci, the perspectives and the factors separately.

The phases of the framework

The importance of addressing evaluation of learning environments over a period of time is highlighted in several of the items reported in the literature review presented in the previous chapter. The use of declared phases for the framework has an orientation to considering learning spaces as ecosystems and to acknowledging the relational nature of the development of learning activities and experiences in learning spaces.

There was considerable similarity between both the terms used and the concepts they represented in considering the use of time phases in the evaluation of learning spaces presented in the literature.

Johnson and Lomas (2005) presented a Conceive/Design/Implement/Operate (CDIO) model(Chris Johnson & Cyprien Lomas, 2005) while the Pedagogy/Space/Technology (PST) model presented by Radcliff et al (2008) used the same terminology (conception and design, and implementation and operation) but clumped them into two phases for their purposes. Lee and Tan (2008) proposed a three phase model of design, build, occupy in a constantly recurring cycle. The framework presented by Blackmore et al (2011)had a specific orientation to schools with four declared time phases (Design, Transition, Consolidation, Sustainability).

Given the similarities in the models described above it was not possible to create new terms for the framework developed for this research. The terms design, transition and consolidation were used in a manner very similar to the work of Blackmore et al. The use of the phase of consolidation was seen as significant for its focus on practice and what happens in learning environments as they are used by teachers and students for the ongoing activities of teaching and learning. The one term that is unique for this specific research project is re-appraisal. The particular meanings intended for these terms in describing the phases of the framework are given below.

> Phase 1 – Design – is described as the period of planning the physical and educational features of the new learning environment facility. This would typically focus on sound architectural principles, contemporary educational philosophies and principles and concepts of best practice from both architectural and educational perspectives.

> Phase 2 – Transition – is described as the period of first occupation and use of the new learning environment facility. In this phase there is a focus on moving in to and occupying a new facility, organising services and resources necessary for the use of the facility and developing new organisational arrangements such as rules and protocols that will direct people's use of the facility.

> Phase 3 – Consolidation – is described as the period of implementing the ongoing education practices of the new learning environment facility. There is diversity of opinion as to how evaluation can best be implemented in this phase of the cycle as researchers move away from a deterministic premise that lends itself to traditional post occupancy evaluation approaches to a more socio-spatial approaches that emphasise qualitative studies of how the uses of learning environments change through a range of iterations over time.

> Phase 4 – Re-appraisal – is described as the period of exploring future options for the educational use of the learning environment facility. While most literature in the field

suggests that this phase looks at sustainability of practices that have developed in the new learning environment, this model proposes that there could also be a desire to deliberately change these practices. Such change could involve consideration of the capacity of the facility to be reconfigured in some significant way, and for education practices to be changed in response to internal or external pressures.

While the phases are presented here as discrete items, it is not expected that there would be such clear-cut delineation in practice. The discrete descriptions here are to help focus the subsequent development of the framework. It is anticipated that in practice there would be overlap between the phases and constant cycling through the phases as the natural progression of a project that was developing the implementation of innovative education practices in innovative learning environments. The usefulness of the phases presented in the framework for practitioners is examined through the research. It is accepted that feedback gathered through the research could lead to a reconsideration of the phases in organising the framework. This is in line with Robinson's emphasis of the iterative nature of Conceptual Modelling.

The foci of the framework

The framework had two declared foci: a learning environment focus and an education practice focus. These foci were broad organising concepts used to support the cross-disciplinary nature of the research. The foci were used to guide a balanced consideration of issues to be considered as factors for inclusion in the framework. Deliberate engagement with the foci helped ensure that both learning environment issues and education practice issues were duly considered at all phases of the framework.

The literature examined that had a focus on learning environment design tended to identify issues for evaluation predominantly in the first two time phases as declared for this framework; that is in the periods of design and transition, where transition was seen as the period of first occupation. Following this pattern tended to reinforce an orientation to traditional post occupancy evaluation. Giving consideration to the learning environment design focus across all time phases helped produce a more even spread of issues and factors to be considered with an intention that this could lead designers to be more explicitly engaged in all phases of the process than may have previously been the case.

The literature on education practice presented issues and factors across all phases of the framework. The critical factor for the development of the framework was to identify the most significant issues to be included. Consideration of the phases helped identify the best location for some of the issues. Further consideration through the perspectives presented in the following section was also important in helping identify the most appropriate factors for inclusion from the perspective of education practice. The foci are important in shaping the inputs for the framework in the Conceptual Modelling approach applied to this research.

Although the foci were organising concepts for developing the subsequent details of the framework (the factors) they were not examined directly in the research. It was possible, however, to surmise that experts from the two backgrounds of architecture and education were generally equally comfortable responding to factors that had originally been derived from the background of either one of the declared foci.

The perspectives of the framework

The purpose of the perspectives in the framework was to help refine the identification of issues that could be included as factors for evaluation in the framework. The perspectives provided a further level of detail derived from the particular focus to which they are attached and further support shaping the inputs in Conceptual Modelling. The perspectives were a unique feature of the framework and as such were not derived directly from the literature in the manner of the other components of the framework. The perspectives were used to maintain coherence between the inputs and the content of conceptual modelling. The perspectives were significant in helping this research make an original contribution to the field.

Whilst the perspectives have specific labels in the framework, they are intended to promote critical consideration of key issues rather than merely label and locate. As such they reflect the questioning approach of the PST model and a similar questioning approach will be used to help inform understanding of the perspectives within the framework. Some of the questions used are very similar to the questions presented in the PST model (Radcliffe et al., 2008).

The conceptualisation of the perspectives was based on a pattern of one declared perspective for the learning environment focus at each phase and three perspectives for the education practice focus at each phase. The education perspectives presented in the framework represent a wide range of thinking in leadership for innovation in education but further detail drew most heavily on the works of Owens and Valesky (2015), Gislason (2010) and the CERI report (2013) referred to in the previous chapter.

Oblinger highlights the point that "learning spaces mediate the relationships and social practices of teaching and learning, and are only one factor among many in the complex relationships of teaching that inform learning outcomes" (Lomas & Oblinger, 2006, p. 5). Blackmore et al provide a conceptual framework for their literature review to help organise this complexity. Their framework addresses the perspectives of Practitioners / Learners / Space over the time phases of Design / Implementation and Transition / Consolidation / Sustainability and Re-evaluation. Blackmore et al develop their framework from the perspective of impact on pedagogy. The key issues that will be investigated in this project are represented in the table below.

Table 3: Framework for investigating innovative pedagogical practices and innovative learning environments (adapted from Blackmore et al, 2011).

Development Phase	Impact on Pedagogy
Design	Consultation in design Clarifying educational / pedagogical principles Preparation for pedagogical change
Implementation & Transition	Orientation to space Rethinking pedagogical approaches Professional learning Utilising space
Consolidation	Changes in pedagogy

	Adaptive use of space Changing relationships and space Changing organisation and operation for space
Sustainability & Re-evaluation	Evaluation for innovation

There is wide ranging acknowledgement that research in the field of innovative learning environments and innovative education practices is derived from a range of backgrounds with areas such as architecture, interior design, education design, environmental psychology, educational leadership, pedagogy and learning theory among those most commonly cited (Blackmore, Bateman, O'Mara, et al., 2011; Cleveland & Fisher, 2013). Higgins et al (2005) warn against the dangers that can arise from a focus on "architectural determinism" especially in not allowing for local variations and ownership of programs. Mulcahy et al (2015b) promote the premise provided by thinking about space from a relational, socio-material perspective to offer a less deterministic causal account of change. Higgins et al argue that participatory or generative design involving students and teachers needs to continue through all phases from design to evaluation in order to achieve meaningful impact within a rapidly changing context. Blackmore et al assert that "buildings alone are not enough: it is about relationships and changing cultures and practices" (Blackmore, Bateman, O'Mara, et al., 2011, p. 19) and suggest that the different paradigms and perspectives of research and analysis are converging on agreement for the need to focus on the relationship between contextual, organisational, pedagogical and social practices in different learning spaces.

Blackmore et al suggest the key interconnected elements necessary to sustain innovation and improvement in programs relating to the spatial dimensions of schooling as:

> "the school organisation and whole school processes and practices that inform ethos or culture of inquiry of learning …(and) sustaining teacher, community and students voice gained through participatory design and embed participation in everyday practice and decision making and thus enhancing teachers' and students' sense of self efficacy and agency" (Blackmore, Bateman, O'Mara, et al., 2011, p. 22).

The ILE report (Development, 2013) also emphasises that "both the elements and the relationships are important". The elements of the ILE model are Resources/Learners/Content/Educators (p. 24). These are linked in a dynamic relationship through the core features of Pedagogy and Organisation. The significance of the relationships in offering dynamic linking between the elements is that this provides agency in shaping the development of the environment. In a school context the agency will be most significantly influenced by the leadership and organisational strategy and how this is acted on by the learning environment as an organisation.

Details of the perspectives

The following table presents the shaping questions that are intended to inform the understanding of the perspectives as they help identify the issues of greatest significance at that point in the framework.

Table 4: Summary of Phases, Foci, Perspectives and Shaping Questions.

PHASE	FOCUS	PERSPECTIVE	SHAPING QUESTION
Design	Learning Environment Focus	Design Innovation	Does the design represent best practice in innovation in the field?
Design	Education Practice Focus	Cultural Alignment	Does the design reflect the educational ambitions and priorities of the school?
Design	Education Practice Focus	Pedagogical Development	What types of teaching are we trying to foster?
Design	Education Practice Focus	Learning Styles	What types of learning are we trying to foster?
Transition	Learning Environment Focus	Occupancy and Operation	Is the facility working effectively for its intended purposes?
Transition	Education Practice Focus	Orientation and Adoption	Are all users able to make best use of the new learning environment?
Transition	Education Practice Focus	Operation and Management	Are the teachers able to operate effectively in the learning environment?
Transition	Education Practice Focus	Engagement and Relationships	Does the learning environment promote engagement and well-being amongst the students?
Consolidation	Learning Environment Focus	Sustainability	Can the facility support all of the teaching and learning practices that are occurring?
Consolidation	Education Practice Focus	Quality Assurance	How will we know if the project is delivering quality outcomes?
Consolidation	Education Practice Focus	Spatial Competence	What pedagogical changes are required by the learning spaces?
Consolidation	Education Practice Focus	Learning Experiences	Are the learning experiences of the students reflecting the learning intentions of the project?
Re-appraisal	Learning Environment Focus	Adaptability	Can the facility be reconfigured for further innovative uses?
Re-appraisal	Education Practice Focus	Re-imagining	Does the new facility support future goals in teaching and learning?
Re-appraisal	Education Practice Focus	Creative Re-engagement	Are teachers able to change their pedagogy to use the facility in different ways?
Re-appraisal	Education Practice Focus	Learning Futures	Does the learning environment support new approaches to learning by students?

The questions presented above were intended to help the interpretation of the perspective in selecting the specific issues that should be identified as the factors associated with that perspective. While the concept of the shaping questions being derived from the PST approach

is acknowledged above, the questions presented here are expressed in their own way in a manner that is seen as most appropriate to the framework as it is being developed. The framework was structured with a pattern that defined the number of factors associated with each perspective. While this numbering was essentially arbitrary it helped bring definition to an area of complexity that was often overwhelmed by seemingly never-ending lists. The questions helped provide a qualitative interpretation of appropriate issues. The questions were used in a similar manner in the interpretation of the data to help inform decisions about what were considered the most significant factors for inclusion in further iterations of the framework.

The factors of the framework

The factors of the framework were the content component of the Conceptual Modelling approach. The factors describe the scope of the model and the level of detail included in the model. Decisions about the content of the model were based on assumptions about uncertainties and simplifications to be incorporated in the model (Robinson, 2008b, p. 14). The identification of factors for the framework developed here addressed a key assumption that professionals and practitioners from the different fields of architecture and education would have similar understandings about the issues being investigated. A further series of assumptions were made about the degree of complexity appropriate to the model. Judgements about content based on these assumptions were made in the context that a declared objective of the framework was to support the development of a questionnaire that could be used to further interrogate the framework, and that this would be done using an Expert Elicitation approach in the subsequent research.

There were 71 factors presented as the content in the initial framework (see table 5, below). They were presented in a regular pattern derived from aspect of the inputs - the key perspectives at each phase. These factors were selected from a pool of over 400 identified through the literature review. Key literature used in identifying the terms for the frameworks was discussed in the previous chapter.

The literature review undertaken by Blackmore et al (2012) presented a list of 98 keywords and themes derived from their study of the literature. Through consideration of other frameworks 90 further key terms were identified. In some of the frameworks the key terms had subsets. Terms in these subsets added a further 104 to the pool. The New Zealand Ministry of Education Innovative Learning Environments guide used 121 key terms in its extended on-line form (2017). There was considerable overlap and repetition of terms across the various lists so it is not possible to say that 400 discrete terms were considered.

The identified terms were derived from 19 separate documents. The full list of the terms and the accompanying comments that helped inform an understanding of the terms are presented in a consolidated table in Appendix 5. Three examples from this table are presented below. These examples are intended to be indicative the list of terms that was accumulated and the pattern of commentary that was used to help inform interpretation of these terms.

Table 5: Selected examples of terms identified from framework documents used for this research.

Author(s)	Key Terms	Key Features	Relationships / Dynamics	Origin	Key Purpose	Comment
Copa & Pease *(1992) New Designs for the Comprehensive High School*	Learning Signature Learner Outcomes Learning Process Learning Organization Learning Partnerships Learning Staff (Learning Technology) Learning Environment Learning Cost	The model describes a comprehensive consultative process "Design Down" and provides design specifications to help interpret each point.	The process is presented as being tightly sequential to support an extensive consultation process to develop a widely supported design proposal.	Developed through the National Centre for Research in Vocational Education with an orientation to making high schools more suited to "preparing students for a changing world".	A model for stakeholder consultation in a learning environment development project.	The model presents and archetype for a new facility of 100 student family, 400 student neighbourhood, 1600 student community. The model and process were used in Iceland in a new school development project and was the basis of an evaluation project (Sigurdardottir & Hjartarson, 2011)

Author(s)	Key Terms	Key Features	Relationships / Dynamics	Origin	Key Purpose	Comment
Owens & Valesky *(2015) Organizational Behaviour in Education: Adaptive Leadership and School Reform*	Ecology Organization Culture Milieu	Building and facilities Technology Pedagogical Inventions Communication Patterns Decision-making patterns Hierarchy Formal Structure Bureaucratization Assumptions Values Norms/beliefs Behaviour patterns Artefacts Race, ethnicity, gender Motivation Leadership Socioeconomic levels Status	The four dimensions are said to be "dynamically interactive", but the nature of this interaction is not elaborated. The dimensions sit within an external environment: social, political, economic, technological, legal, demographic, ecological and cultural systems.	The model sits in a theoretical context of organizational management. The authors acknowledge the work of Renato Tagiuri in organizational culture and business systems.	The purpose of the framework is to offer a model of organizational culture and organizational climate that can be used by school leaders to manage school reform projects.	Although the concept of "ecology" (building and facilities, technology, pedagogical inventions) is a part of the model the concept is not elaborated at all in the text and is not addressed as a part of the dynamic of the model.

Author(s)	Key Terms	Key Features	Relationships / Dynamics	Origin	Key Purpose	Comment
Blackmore et al (2011) *The connections between learning spaces and learning outcomes: people and learning places?*	Practitioners Learners Spaces Design Transition Consolidation Sustainability / Re-evaluation	The framework uses a matrix of Practitioners / Learners / Spaces with the time phases of Design / Transition / Consolidation / Sustainability / Re-evaluation to identify 50 separate elements.	The text makes several references to the complexity of the relationships between the organising concepts and the separate elements, but the framework does not help identify a purpose or pattern to relationships.	The framework was developed by the project as an organising tool for the literature review.	Organising framework for literature review.	The framework and report highlight the challenge of maintaining elegant simplicity in conceptualising the key elements, time phases and relationships in learning environment evaluation.

The criteria for selecting the terms to become the factors in the research framework were based on the criteria declared for establishing the overall organisation for the framework: i.e. they represent cross-disciplinary perspectives, they represent the declared time phases of the model, they represent significant contemporary issues in the field. The factors were then considered in the light of the shaping question for each perspective.

The 71 factors identified for the initial version of the framework were identified according to the metric previously described. These 71 factors were not considered a given set for evaluation in every or any situation. The purpose of the framework is to help a user group identify the set of issues that they consider most appropriate to their circumstances. This individual profile of issues spread across the phases and perspectives of the framework will provide the basis for a user group to determine what evaluation strategy will be most appropriate to their circumstances.

It is appropriate to mention at this point that the framework thus constructed was a theoretical construct in line with the methodology of Conceptual Modelling. Trialling of the framework as the next phase of the research identified some key points to be addressed and the number of factors in the framework was reduced for the version that was used for the research. The processes, criteria and outcomes relating to this are presented in detail in the following chapter. The details of the factors in the framework presented here are the original set based on the theoretical analysis.

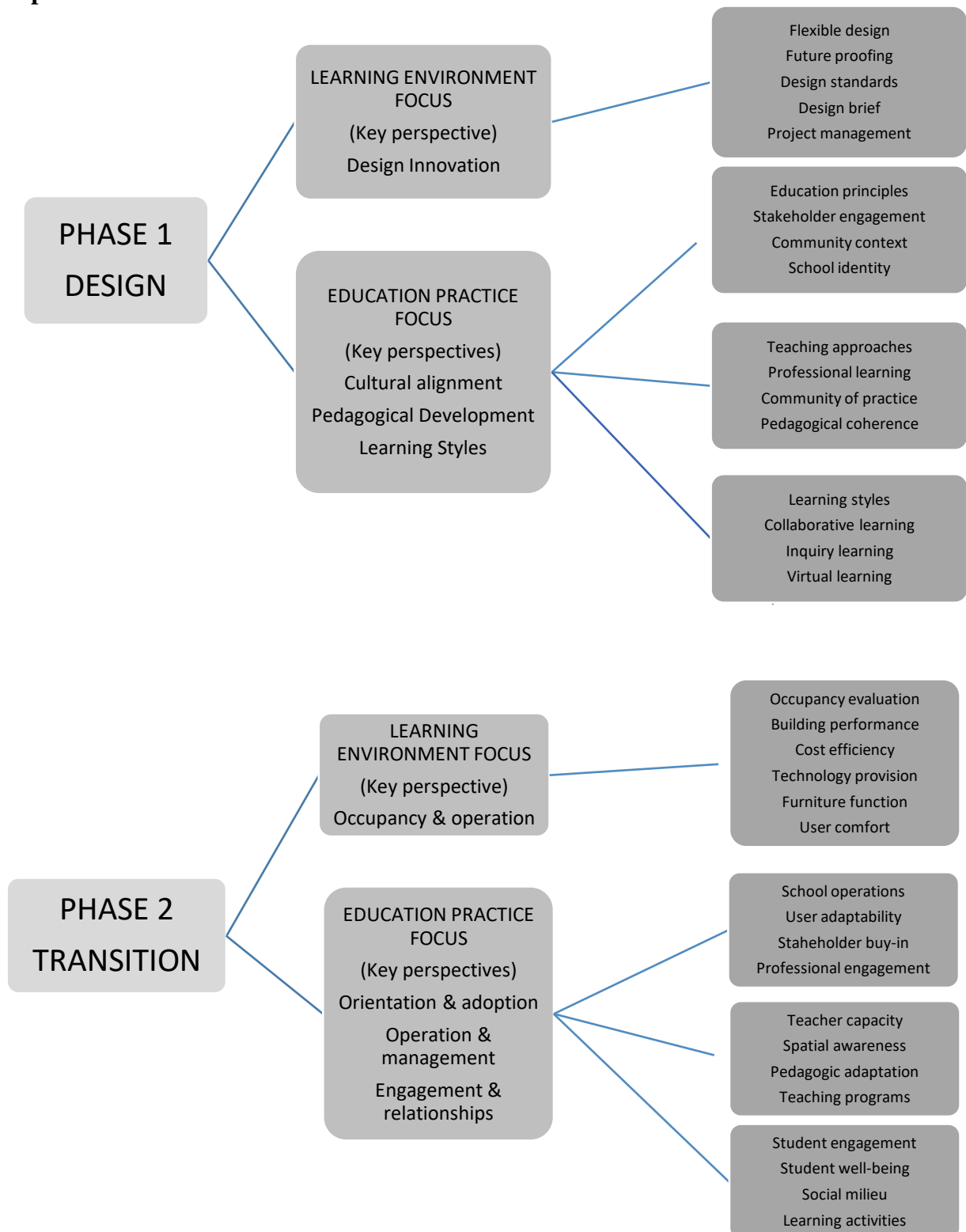*Table 6: A list of the Factors used in the framework.*

PHASE	FOCUS	PERSPECTIVE	FACTORS
Design	Learning Environment Focus	Design Innovation	- Flexible design - Future proofing - Design standards - Design brief - Project management
Design	Education Practice Focus	Cultural Alignment	- Education principles - Stakeholder engagement - Community context - School identity

Design	Education Practice Focus	Pedagogical Development	- Teaching approaches - Professional learning - Community of practice - Pedagogical coherence
Design	Education Practice Focus	Learning Styles	- Learning styles - Collaborative learning - Inquiry learning - Virtual learning
Transition	Learning Environment Focus	Occupancy and Operation	- Occupancy evaluation - Building performance - Cost efficiency - Technology provision - Furniture function - User comfort
Transition	Education Practice Focus	Orientation and Adoption	- School operations - User adaptability - Stakeholder buy-in - Professional engagement
Transition	Education Practice Focus	Operation and Management	- Teacher capacity - Spatial awareness - Pedagogic adaptation - Teaching programs
Transition	Education Practice Focus	Engagement and Relationships	- Student engagement - Student well-being - Social milieu - Learning activities
Consolidation	Learning Environment Focus	Sustainability	- Facility sustainability - Realisation of affordance - Operational refinement - Occupancy adaptation
Consolidation	Education Practice Focus	Quality Assurance	- Consolidated practice - Quality indicators - Stakeholder consultation - Cultural profile
Consolidation	Education Practice Focus	Spatial Competence	- Pedagogical flexibility - Spatial optimisation - Professional practice - Operational alignment
Consolidation	Education Practice Focus	Learning Experiences	- Student achievement - Student ownership - Student voice - Learning connections
Re-appraisal	Learning Environment Focus	Adaptability	- Facility adaptation - Viability - Facility reconfiguration

				• Stakeholder engagement
Re-appraisal	Education Practice Focus	Re-imagining	• Professional re-imagining • Community engagement • Quality indicators • Developmental leadership
Re-appraisal	Education Practice Focus	Creative Re-engagement	• Pedagogical innovation • Spatial innovation • Operational responsiveness • Professional excellence
Re-appraisal	Education Practice Focus	Learning Futures	• Learning futures • Quality achievements • Learning culture • Student engagement

The framework presented above focussing on the list of factors looks like a series of lists. The framework can be presented in sections that help clarify the nature of the factors as they relate to each Phase / Focus / Perspective in the following manner. The representations presented below use each phase as the key organising concept. This helps to give a clearer overview of the full content of each phase. It is appropriate to present the framework in this manner as the phases are considered to be unique conceptual organisers of the framework. The value of the phases in organising the framework is investigated through the subsequent research.

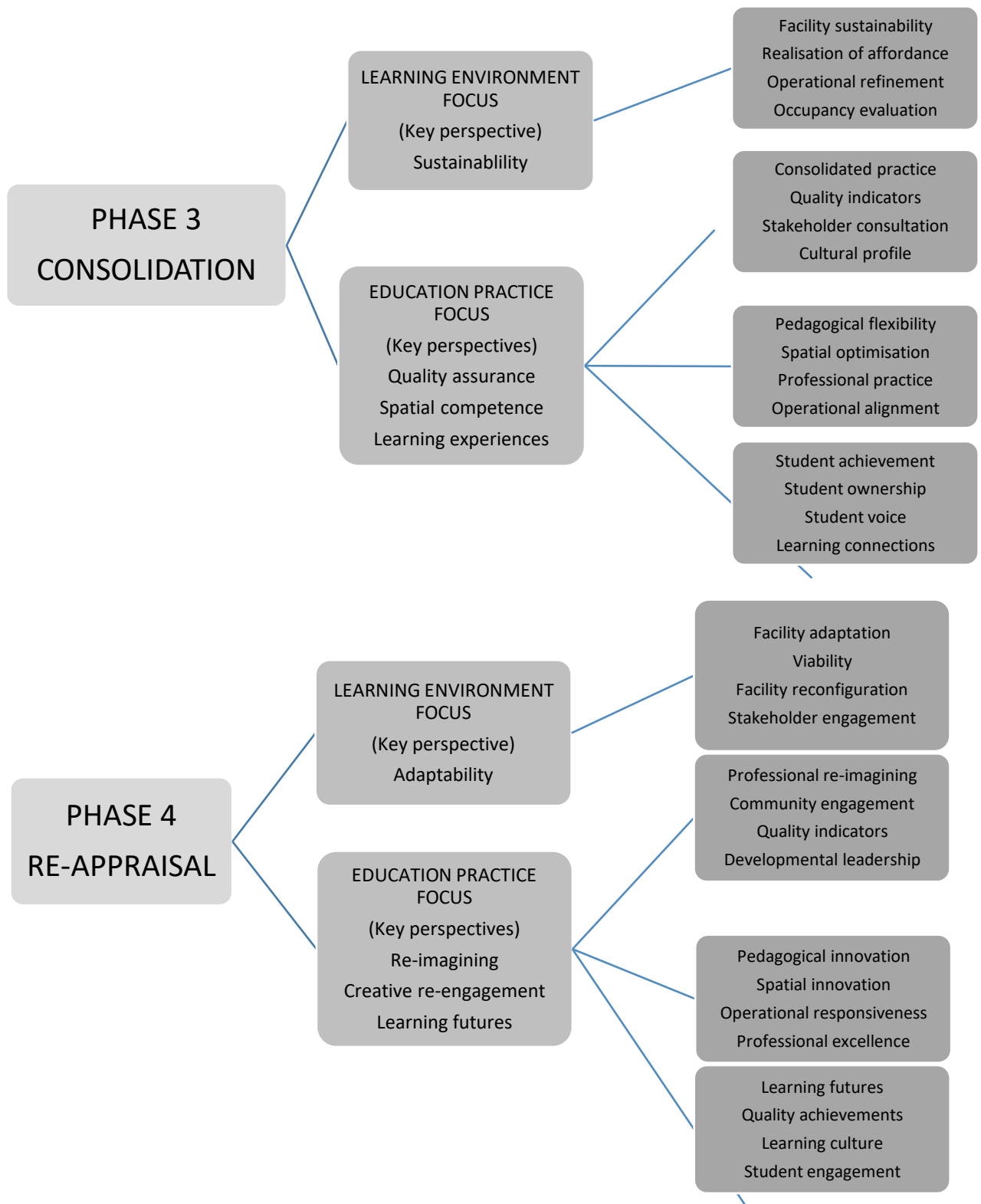**Framework for learning environment showing the relationship between Phases, Foci, Perspectives and Factors**

PHASE 1
DESIGN

LEARNING ENVIRONMENT FOCUS

(Key perspective)

Design Innovation

- Flexible design
- Future proofing
- Design standards
- Design brief
- Project management

EDUCATION PRACTICE FOCUS

(Key perspectives)
Cultural alignment
Pedagogical Development
Learning Styles

- Education principles
- Stakeholder engagement
- Community context
- School identity

- Teaching approaches
- Professional learning
- Community of practice
- Pedagogical coherence

- Learning styles
- Collaborative learning
- Inquiry learning
- Virtual learning

PHASE 2
TRANSITION

LEARNING ENVIRONMENT FOCUS

(Key perspective)

Occupancy & operation

- Occupancy evaluation
- Building performance
- Cost efficiency
- Technology provision
- Furniture function
- User comfort

EDUCATION PRACTICE FOCUS

(Key perspectives)
Orientation & adoption
Operation & management
Engagement & relationships

- School operations
- User adaptability
- Staheholder buy-in
- Professional engagement

- Teacher capacity
- Spatial awareness
- Pedagogic adaptation
- Teaching programs

- Student engagement
- Student well-being
- Social milieu
- Learning activities

Figure 5: Framework for learning environment showing the relationship between Phases, Foci, Perspectives and Factors

Conclusion

The framework presented here was a theoretical construct developed from a literature review of the field. The framework was developed using a declared Conceptual Modelling approach. The purpose of the framework was to provide conceptual coherence and guiding principles for identifying a set of factors to be included in the research questionnaire for this study. The framework incorporates four key features of Phases / Foci / Perspectives / Factors in an original manner. The decisions about determining the set of factors for the framework were informed by a set of shaping questions. The pattern of the framework determined a certain metric that had identified 71 factors as relevant at this stage. The validity of the framework and the significance of the factors for inclusion in the framework were investigated through the research methodology of Expert Elicitation using an online questionnaire.

Chapter 4: Research Methodology and Method

Introduction

This aim of this research was to develop a framework to facilitate the evaluation of innovative education practices in innovative learning environments. The research aimed to create a framework that allowed users to develop a profile of significant factors appropriate to their particular innovative education project in an innovative learning environment. The research explored how the professional practices of architects involved in learning space design and educators involved in implementing innovative programs in new learning spaces came together.

These matters mean that the research had a pragmatic orientation focussed on the professional work of practitioners from the fields of architecture and education. The research incorporated the perspectives of architects and educators in reasonable balance and represented the issues of significance for such practitioners.

A pragmatic use of a mixed methods research approach with an orientation to qualitative analysis and interpretation was seen as most appropriate in this context. The specific research methodology of Expert Elicitation was used to efficiently enable the engagement of professional practitioners as subjects in the data collection.

The research approach

The research approach for this study was shaped by an organising concept of pragmatism. An approach based on pragmatism suited both the purpose and nature of this research. Since the purpose of the research was to develop a framework that integrates the perspectives of architects and educators in relation to the implementation of innovative education practices in innovative learning environments a pragmatic approach that facilitates such integration without imposing a paradigm from either perspective over the other was considered appropriate.

The nature of the research was model building, that is, the development of an appropriate framework. Such model building required qualitative judgements about the data collected through the research questionnaire. Pragmatism supports a mixed methods research approach with an orientation to qualitative analysis and interpretation.

Morgan (2007b) argues that pragmatism can serve as a philosophical program for social research that can accommodate qualitative, quantitative and mixed methods approaches. As an organising concept pragmatism focusses on the immediate practicality of issues such as research design, rather than determining research in terms of ontology, epistemology and methodology. Johnson and Onwuegbuzie (2004) propose that pragmatism offers a practical and outcomes-oriented method of inquiry that is based on action and leads, iteratively, to further action and the elimination of doubt. Morgan (2014a) suggests, though, that the caricature of pragmatism as merely asking about "what works" is a simplistic interpretation of Dewey's original work. While the fundamental principles of pragmatism are well suited to analysis of problem solving as a human activity, pragmatism as a framing concept for research goes beyond a simple focus on problem solving. Pragmatism places an emphasis on

the "why to" aspects of research as well as the "how to". It is important to note, however, that Dewey preferred to avoid the claim that research is for the production of knowledge in an epistemological sense, and instead that the outcome or research from a pragmatic perspective is "warranted assertions" (p. 1048). Thus, for pragmatism, the production of knowledge as an abstract philosophical concept is replaced by an emphasis on experiences as the continual interactions of people's beliefs and their actions. The purpose of the research was to produce new understandings that reflect the considered inquiry of individuals and communities on issues that are of significance to them. Pragmatism concentrates on beliefs that are most directly connected to actions rather than framing research as a commitment to an abstract set of philosophical beliefs (Morgan, 2014b, p. 1051).

Using a framing of pragmatism was seen as most appropriate for inter-disciplinary research as it helped avoid paradigm polarisations and thus allowed the research to employ design components that offer the best chance of answering their specific research question with an orientation to practical outcomes. A pragmatic approach "rejects the need to choose between a pair of extremes where research results are either completely specific to a particular context or an instance of some more generalized set of principles" (Morgan, 2007b, p. 72).

The research approach for this study was informed by this contemporary understanding of pragmatism with a focus on the following features:

- Pragmatism allows for the unqualified integration of perspectives from different disciplines (architecture and education in this case)
- Pragmatism accepts that all individuals will have their own unique interpretation of the situation being investigated
- Pragmatism suggests that the purpose of the research is to develop an iterative understanding of the situation being investigated, rather than a definitive statement of new knowledge.

This pragmatic concept of research and evaluation reflecting each other is presented in the work of Alkin & Taut (2003) and Carden & Alkin (2012) and represented in the diagram below.
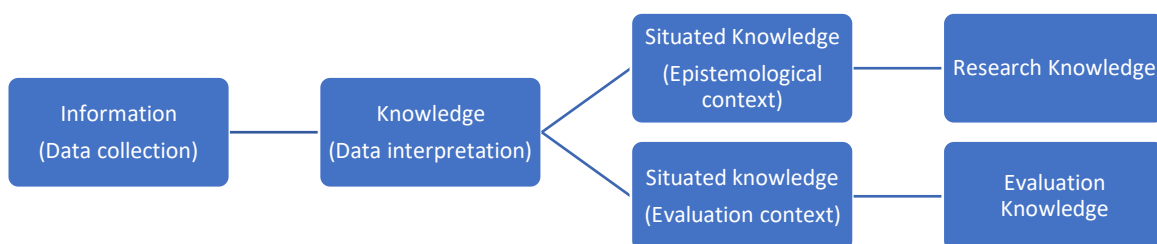

Figure 6: A representation of the relationship between research and evaluation (after Alkin & Taut, 2003).

Alkin and Taut point out that research and evaluation proceed in a similar fashion, but for different purposes and uses. In the case of research, the goal is generalizable knowledge that contributes to the body of knowledge in a particular field, whereas for evaluation the purpose is context specific with the knowledge being intended for use by a particular group of people

in a particular setting at a particular point in time. Hence, while the project reported here is academic research, it is modelling the likely approaches to be used in the evaluation phase that will follow.

This pragmatic approach to the relationship between research and evaluation is also complementary with the Developmental Evaluation approach to evaluation described in Chapter 2. Patton states that "Developmental Evaluation supports innovation development to guide adaptation to emergent and dynamic realities in complex environments" (2012, p. 1). Developmental Evaluation has the evaluator situated within the program, as does the goal for the pragmatic outcome of this research of facilitating practitioners in professional activities utilising their own evaluations. This pragmatic integration of research and evaluation knowledge is seen as ideal in supporting evaluative thinking and ongoing reflection to help projects cope and adapt in complex and challenging environments (Carden & Alkin, 2012, p. 110).

The methodology of Expert Elicitation

The general concept of Expert Elicitation and its relationship to the theoretical research undertaken using the Conceptual Modelling approach was discussed in Chapter 2 of this thesis. This section describes the specific research undertaken using the methodology of Expert Elicitation. Expert Elicitation was used to gather qualitative data that was used to evaluate the theoretical framework that was described in Chapter 3.

Expert Elicitation is a process of gathering information and data from qualified individuals that can be interpreted to solve problems and make decisions in the designated field of investigation (Meyer & Booker, 2001). The major applications of Expert Elicitation are considered to be determining the probability that a key event will take place, predicting the performance of a product or a process, determining the validity of assumptions used to select a model for analysis and selecting input and response variables for a chosen model. These applications of Expert Elicitation are all closely aligned with the organising process of Conceptual Modelling used in the first phase of this research.

Expert Elicitation gathers responses by experts to a designated technical problem or issue. Experts are generally considered to be people who have a background in the subject area and are recognised by peers or by those conducting the study as qualified to answer the question(s). Expert Elicitation usually involves selecting experts in the field according to designated criteria, designing elicitation methods, specifying the response mode and the process for collecting the data.

Expert Elicitation is a process of gathering experts' best representations, or a snapshot, in response to the question(s). The process of building multiple expert opinions is valuable because it is very efficient in getting wide ranging responses that can be compiled to reflect the most up to date consensus on the issue.

Expert Elicitation was seen as a most appropriate methodology for this research as it supported the integration of perspectives from different disciplines, it accepted each expert as being valid in their own right and provides for a process of iterative analysis of data that can provide outcomes that represent the most appropriate responses to different circumstances (Slottje, Sluijs, & Knol, 2008).

A rationale for Expert Elicitation

Using Expert Elicitation for consensus building is seen as extremely valuable in areas of high complexity characterised by uncertainty around technical specificity in a dynamic environment. These are certainly characteristics that apply to evaluating 21_{st} century learning environments.

This research used the guiding questions stated earlier to shape its elicitation of expert understandings of 21_{st} century learning environments. It is appropriate to restate the guiding questions here so they can be directly considered in the context of Expert Elicitation.

    a. What factors do experts see as extremely significant for the evaluation of innovative education practices in innovative learning environments?

    b. What factors do experts see as not significant for the evaluation of innovative education practices in innovative learning environments?

    c. What factors should be included in a framework for the evaluation of innovative education practices in innovative learning environments?

    d. How can a framework for the evaluation of innovative education practices in innovative learning environments be used to facilitate the selection and implementation of the most appropriate approaches to the evaluation for identified situations in the field?

The use of Expert Elicitation for this research looked to build common understanding and validity of the assumptions around the factors that were seen as most significant in designing and implementing 21_{st} century learning environments and a framework for evaluating 21_{st} century learning environments in relation to these assumptions. The methodology of Expert Elicitation was seen as most applicable to this scenario as it has the capacity to work across different disciplines. It was intended that the use of Expert Elicitation would help clarify conceptual understandings, the use of language, and the procedures for evaluation in the field in a cross-disciplinary manner (Meyer & Booker, 2001).

While this rationale for the research methodology of Expert Elicitation seems well founded there do not appear to be any previous instances of such a methodology being used in this particular context for this specific purpose. Thus, this research is exploring the implementation of a new methodology for research in the field.

Processes for shaping Expert Elicitation

Expert Elicitation is essentially a particular application of a mixed methods approach. As such Expert Elicitation follows a general sequence of steps as follows.

- Select the question area and specific questions.
- Refine the questions
- Identify and engage the experts
- Identify the process of elicitation
- Design and develop the elicitation process
- Collect the data (responses)

The process is not tightly sequential, but rather iterative. One of the strengths of Expert Elicitation as a methodology is that it can manage data being continually refreshed.

The analysis and interpretation of the data is a process separate from the elicitation. The particular processes of quantitative and qualitative interpretation of the data can be developed and adapted as patterns in the data emerge. Since this research has an orientation to building conceptual understanding through Conceptual Modelling the analysis of the data will have a qualitative orientation.

Issues relating to Expert Elicitation

There are certain assumptions embedded in Expert Elicitation that need to be acknowledged as a part of building the case for the methodology.

In general, experts know the state of art of their field better than non-experts. In particular this means that experts are better at making connections within their field, and also at understanding the limitations of their field and identifying what is not known and what is worth further investigation and understand (Meyer & Booker, 2001; Slottje et al., 2008).

Experts are also better at providing insights on how problems can be solved. Experts are better able to solve a problem in their field and can estimate how much confidence can be placed in the solution. The elicitation process needs to provide a sufficient body of responses to enable broad patterns of prediction to be developed, rather than specific individual predictions.

Experts, like people in general, will not follow a normative distribution in their response patterns. This means that it is not appropriate to impose Bayesian modelling on to data analysis when the purpose of the analysis is to construct and confirm a new model. Model building derived from Expert Elicitation can best be done using statistical techniques of cluster analysis (Meyer & Booker, 2001, p. 214).

Clustering refers to the data's grouping patterns. Clusters form according to how the values from a single variable (significance of factor) are grouped, or how the different variables are grouped. Cluster analysis determines how values of one or more variables can be grouped together. These clusters present the basis of a model or framework to be developed to answer the research questions declared above. Expert Elicitation is efficient in providing a valid pool of data for such analysis from a relatively small body of respondents (Slottje et al., 2008). The specific statistical techniques used for cluster analysis are described in the subsequent chapter "Analysis and Interpretation of Data".

Selection of experts

The identification and selection of experts should establish a well-composed and balanced sample of experts in the designated field(s), who are able to make express judgements on the uncertainties relating to the issues that are to be elicited (Slottje et al., 2008, p. 17).

An expert is someone especially knowledgeable in the field and at the level of detail being elicited and is recognised by their peers or those conducting the survey as qualified to answer

the questions (Meyer & Booker, 2001, p. 85). For this study the field of expertise being investigated is the relationship between the design of innovative learning spaces and education practices in innovative learning spaces. Hence, respondents were sought with appropriate expertise in architecture with an orientation to the design of education facilities, and education with experience in the leadership of implementing education programs in new learning space facilities.

The experts were identified through negotiation with peak professional associations in the relevant fields. The specific associations approached were the Australian Secondary Principals Association and Learning Environments Australasia. The presidents of each association were asked to seek expressions of interest from their members to act as experts for the study and to provide email contact details so people could be approached on an individual basis. It was also appropriate to identify further experts through the recommendation of invited respondents through a snowballing process.

A record of the profile of the expertise of the respondents was kept through their responses to questions 1 – 5 in the questionnaire. Respondents were profiled for their expertise in architecture or education, or a combination of both. Respondents were also profiled as to whether their expertise is through academic qualification, professional experience or a combination of both.

Determining the number of experts to be included in the study is essentially a judgement call of the researcher guided by the following examples from other Expert Elicitation research. Ayub (2001), in a major study on risk analysis for the US Army, says that "the size of an expert panel should be determined on a case by case basis" (p. 19) but does not declare in his paper the exact number of experts engaged for his study. Meyer and Booker suggest that the number of experts should be about 10 percent of experts in the field and that this might range from 4 to 50 individuals (2001, pp. 85, 88).

Slottje et. al. (2008) in their paper that provides methodological suggestions for using Expert Elicitation in environmental health studies identified 6 to 12 experts as being the range used in most of the studies they investigated (p. 19). They concluded that at least six experts are needed to ensure robustness of results, and that beyond twelve experts the benefits of including additional experts begins to drop off. Cooke and Probst (2006b) identified the same target range of experts and presented a similar rationale based on their work with a symposium of researchers with experience in using Expert Elicitation. Aspinall (2010) declares that through his experience with more than 20 panels of Expert Elicitation 8 – 15 experts is a viable number and that getting more will not change findings significantly, but admits that these ideas are not rigorously tested (p. 295).

The determination of numbers presented above are generally based on a panel approach to engaging the experts that involves the logistical requirement of bringing the panellists together (either physically or virtually) at a particular point in time for an integrated discussion. The costs involved in such processes were also a determinant in limiting the number of experts involved.

The current study used an online questionnaire that the experts responded to individually and did not require interactive iterations of responses. The data analysis techniques of cluster analysis for model building allow for further responses to be added into the analysis at any time without compromising the integrity of the data. A unique feature of this research was to

bring together the perspectives of the two disciplines and professional practices of architecture and education in the one model of analysis of issues. However, since the issues included in the model had an orientation to education matters over architecture matters it is considered reasonable to have a higher proportion of educators as respondents. Data analysis was conducted using different combinations of the expertise sets of the respondents in the manner described in the following chapter.

Based on these considerations the number of experts involved in this study was as follows:

- Architecture: minimum number of respondents = 6, maximum number of respondents = 12.
- Education: minimum number of respondents = 8, maximum number of respondents = 15.

Developing and trialling the questionnaire

The purpose of the questionnaire was to obtain responses from experts on the significance of the proposed framework and the factors identified within the framework. A premise of Expert Elicitation is that experts have a sound understanding of the matters of the designated topic being investigated and do not need detailed explanations or justifications of the questions. Experts are able to make judgements quickly in giving their responses. Therefore, the questionnaire was developed in a style that gave a statement of the issue in context and asked for a response on a Likert-type scale. An example of the question style is given below.

Figure 7: A sample question from the research questionnaire, version 1.

The questionnaire was presented in a manner that followed the pattern of the framework and identified factors. The questionnaire comprised 93 questions. Questions 1 – 5 were respondent identifier and permission information. Questions 6 – 28 related to phase 1 (Design) of the framework. Questions 29 – 51 related to phase 2 (Transition) of the framework. Questions 52 – 72 related to phase 3 (Consolidation) of the framework, and questions 77 – 93 related to phase 4 (Re-appraisal) of the framework.

It was recognised that the questionnaire was very lengthy and could be very time consuming to complete and this could result in incomplete responses. A trial of the questionnaire was

conducted with 7 respondents. These respondents were invited to give qualitative comment on the nature of the questionnaire as well as responses to the items.

Feedback from this trial identified three key aspects of the questionnaire that could be modified. Time taken to complete the questionnaire ranged from 38 minutes to 1 hour 37 minutes for people who completed the responses in one session. The average time taken was 54 minutes. Further to this, two respondents took multiple sessions to complete the questionnaire, and while their times cannot be included in the average response time given above, they do indicate that the average time could be considered as greater than 54 minutes. This average time was longer than the time anticipated in planning the questionnaire and therefore considered too long a time to expect of a general pool of respondents.

Several of the respondents commented that some of the issues seemed to be repeated in the question set. This occurred because the issues were identified as appropriate to more than one phase of the framework and therefore questioned separately for each phase of the framework in which they occurred. The comments from the respondents suggested that they did not see differentiation across the phases as necessary. Respondents also commented that they did not see the questions relating to the foci of the framework as necessary to the questionnaire. They felt it was quite sufficient to respond to the issues in their own right without reference to the foci.

This feedback from the trial of the questionnaire prompted three changes to version 2 of the questionnaire with the overall aim being to make it as straight forward and time efficient as possible for respondents. The issues were presented as a continuous list, without being organised in the phases of the framework. This removed repeat questions on the issues and made it appropriate to remove the questions on the foci of the framework. Instead of being forced to follow the declared phases of the framework for their responses respondents were invited to identify the phases they saw as significant in relation to the issues. These changes meant that version 2 of the questionnaire become 61 questions instead of the 93 questions of the original format.

While the questionnaire no longer followed the framework in a rigid manner it was considered that the responses would provide appropriate data to investigate to the two key questions of what issues do the experts see as most significant and how could the framework be organised to best represent these issues. An example of the question style is given below.

Figure 8: A sample question from the research questionnaire, version 2.

Responses were required on a Likert-type scale using the categories "Extremely significant/important", "Moderately significant/important", "Slightly significant/important", "Not significant/important at all" and an option for "I do not want to give a rating for this issue". This form of Likert-type scale can only be considered an ordinal scale that can provide ranking of items along the scale but cannot provide any measured value of the worth of one item in relation to another along the scale. This rank order data was considered quite appropriate to answer the question "What factors do experts consider most significant…?", but the data requires further qualitative judgements to determine what factors could be included in a set called the most significant (Gliem & Gliem, 2003; Jamieson, 2004). In this study, univariate cluster analysis derived from the Likert -style ranking data was used to inform decisions around the most appropriate groupings of significant factors.

Administering the questionnaire

The questionnaire was implemented between October 2016 and February 2017 in accordance with the requirements of the ethics approval of the University of Melbourne Human Research Ethics Committee.

Respondents were approached individually by email. The email contained a letter of invitation to participate in the project, a plain language statement explaining the research, a consent form, a statement of advice for completing the questionnaire and a personal link to the questionnaire in SurveyMonkey. The documentation presented in approaching respondents is provided in Appendix 1.

Twenty-two questionnaires were distributed initially – 10 to architects and 12 to educators. These numbers were in line with the response rates and balances wanted according to the procedures of expert elicitation identified above. The timeframe to respond was left open ended to allow flexibility for the participants. When responses were viewed after four weeks it was seen that 10 responses had been completed and 12 questionnaires had not been accessed at all. It was assumed that those people who had not attempted to respond with four weeks were unlikely to do so in the future so a further 21 questionnaires were distributed.

Times taken to complete the questionnaire ranged from 18 minutes to 1 hour 22 minutes. The average time to complete the questionnaire was 34 minutes, with the average time for architect respondents being 35 minutes and the average time for educator respondents being 32 minutes.

Ultimately 22 completed responses were returned – 9 from architects and 13 from educators. This response level and balance of experts is appropriate according to the guidelines of Expert Elicitation.

Data collection

The questionnaire was developed and administered using the commercial product Survey Monkey. Data collection and initial data analysis was conducted using Survey Monkey tools. Survey Monkey has the capacity to produce a range of charts and display formats based on Microsoft Excel spreadsheets. Such charts can be displayed in PowerPoint format.

When questionnaire responses were closed off all of the data was exported from Survey Monkey in PowerPoint and pdf forms that show the analyses done in Survey Monkey, and in xls and csv formats to allow for further analysis using Microsoft Excel and a related program XLSTAT. The data was transferred to the desktop computer of the researcher for ongoing use. A backup copy of the original data was kept on a separate secure data storage device.

Conclusion

Expert Elicitation is not a tightly defined and prescribed methodology. As such, the use of Expert Elicitation for this research presented a number of issues that needed to be addressed to ensure that the research would be valid. There was no previous model of Expert Elicitation being used in the exact manner applied here so a number of judgements needed to be made when applying expert elicitation to this context. The advantages of Expert Elicitation were around a range of efficiencies it provided in implementing the research.

Identifying experts as respondents to the questionnaire meant there could be an assumption that the respondents had a high degree of familiarity with the technical content being presented. This meant that there was not a need for extensive definitions or explanations of terminology in the questionnaire, even when presenting technical language of the topics under investigation. Working with this assumption it was possible to keep a potentially complex questionnaire in reasonable bounds. While there were some instances of specific questions not being answered this was allowed for through the response format. There were no instances where respondents provided comments about not understanding the nature of the topic or the question presented.

The methodology of Expert Elicitation allowed for managing the number of responses required. Having 22 completed responses from the 41 invitations distributed provided a valid body of data. Having 9 respondents from architecture and 13 from education is above the benchmark of 6 suggested by Slottje (2008) and within the range of 8-15 suggested by Aspinall (2010) and in line with the targets identified by the researcher. Analysing the data using sub-sets of 6 respondents from each of the groups showed highly consistent patterns of results. This aligns with Slottje's claim that that at least six experts are needed to ensure robustness of results, and that beyond twelve experts the benefits of including additional experts begins to drop off.

Using Expert Elicitation also provided a model for how the questionnaire could be used in further situations. It would be quite valid for a team of 10 experts, for example (possibly the leadership team of a school and the leading consultants of an architecture firm) to use the questionnaire to identify the most significant issues that they should address at various phases of a project of developing and implementing an innovative learning environment.

Chapter 5: Analysis and Interpretation of Data

Introduction

This analysis and interpretation of data responds to the two guiding questions:

1. How should a framework to facilitate the evaluation of innovative education practices in innovative learning environments be structured?
2. What factors should be included in a framework for the evaluation of innovative education practices in innovative learning environments?

The purpose of the research was to develop a framework of factors that facilitates the evaluation of innovative education practices in innovative learning environments. The framework should provide for the development of a questionnaire that supports users in identifying the profile of factors most significant to their particular project. The template for the framework and extended list of factors was presented in Chapter 3 of this thesis. The analysis of data from the research is to inform decisions about the review and modification of the framework and list of factors. The pragmatic orientation of this research had the intention of making the framework and set of factors as user efficient and effective as possible for those with appropriate expertise working in the field.

This analysis and interpretation of the data looked at the guiding questions stated above separately. The following chapter discusses implications from this data with an emphasis on the combined impact of the analysis of the data in proposing a revised framework and set of factors to be included in that framework and in a subsequently revised questionnaire that can be used to support situation specific interpretation of the framework.

The processes for data analysis

Three different processes were used to develop the data for analysis.

In the first instance the factors were organised into rank order lists according to the Likert - type responses from the questionnaire. The lists were ordered according to the percentage of respondents agreeing with the designated criteria. Lists were created for the percentage of respondents agreeing with the criteria "Extremely significant/important" and the criteria "Not significant/important at all". These lists were examined according to different respondent sets – all respondents together, architects alone, educators alone and for the four phases of the framework.

Scatter plot diagrams were used to give a visual representation of these lists. The scatter plots can indicate the spread of discrimination in the responses. Comparison of scatter plots can also show if the patterns are consistent for all of the respondent variables analysed. It is important to note, though, that since the original data comes from a Likert-type scale then there cannot be statistical comparisons of the distributions on the scatter plots.

Univariate cluster analysis (UCA) was used to group the factors into clusters based on their distributions on the scatter plot diagrams. K-means clustering of 4 clusters was applied. This is a centroid-based clustering process that creates clusters around a central vector. These

clusters can form groups that indicate the clearly most significant group of factors compared with the clearly least significant group of factors. The clusters created through this process are indicative rather than absolute. It will be seen that some factors vary in their cluster allocation across different data sets. The final decision as to where a factor should sit in the cluster group is a subsequent qualitative judgement.

A series of summaries of data analyses are presented. These are presented in three different groups of data sets. The first group of data sets identifies the most significant factors using the phases of the framework as the variable. The second group identifies the most significant factors using the respondent groups as the variable. The final group looks at rankings using the response of "not significant" as the variable. Each of the individual sets of analysis is presented with a purpose statement, a series of data sets, commentary on the implications of the data and a summary statement on the potential significance of the data patterns.

A number of tables and figures are presented in this chapter. Every effort has been made to present these tables and figures in coherent and appropriately connected forms. This results in some uneven page breaks through the chapter, and two of the tables (12 and 16) are still presented across double pages.

Data analysis by phases of the framework

Table 7: Summary of data sets presented for analysis: Phases of the Framework

Data set	Variable examined	Scatter plot	Univariate cluster analysis	Sorted list of factors	Comments
1. All respondents extremely significant for all phases	Framework phase – all phases	X	X	X	X
2. All respondents extremely significant for phase 1	Framework phase – phase 1	X	X		X
3. All respondents extremely significant for phase 2	Framework phase – phase 2	X	X		X
4. All respondents extremely significant for phase 3	Framework phase – phase 3	X	X		X
5. All respondents extremely significant for phase 4	Framework phase – phase 4	X	X		X

Purpose - This set of data identified the factors that were seen as most significant for the different phases of the framework. It also identified a consolidated view of the factors across all phases of the framework using combined average scores. The four phases of the framework were considered a unique and fundamental feature of the framework when it was developed as a theoretical construct derived from the literature review. This set of data analysis identified the degree to which the expert responses correspond with this fundamental original premise for the framework.

Data set 1: all respondents "extremely significant" for all phases
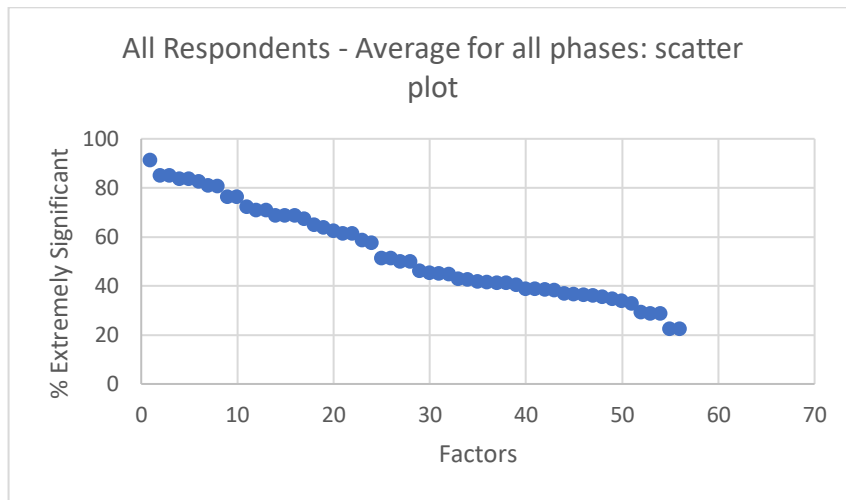

Figure 9: Scatter plot distribution of responses for all respondents rated extremely significant for all phases.
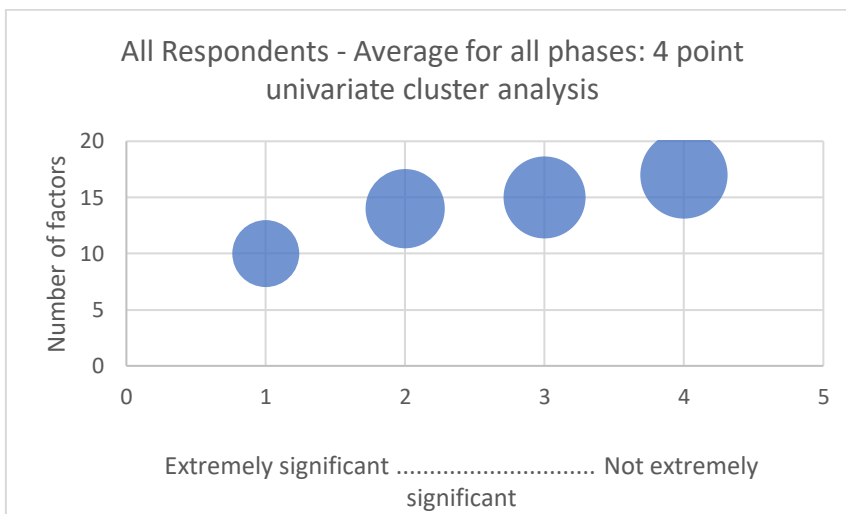

Figure 10: 4-point univariate cluster analysis of responses for all respondents rated extremely significant for all phases.

Table 8: List of factors identified in clusters by 4-point univariate cluster analysis of responses for all respondents rated extremely significant for all phases.

Factors Cluster 1 (10) High extremely significant	Factors Cluster 2 (14)	Factors Cluster 3 (15)	Factors Cluster 4 (17) Low extremely significant
Education Principles Student Engagement Learning Culture Stakeholder Engagement Teaching Approaches Student Well-being Student Voice Pedagogical Innovation Integrated Technology Professional Engagement	Student Ownership Pedagogical Flexibility Professional Practice Collaborative Learning Inquiry Learning Teacher Capacity Stakeholder Consultation Social Milieu Stakeholder Buy-in Virtual Learning School Identity Learning Styles Professional Learning	Learning Activities Flexible Design Community Context School Operations Student Achievement Design Brief Spatial Innovation Furniture Function Evaluation Future Learning Learning Connections User Comfort Evaluation Developmental Leadership Facility Viability Spatial Awareness Teaching Programs	Building Performance Evaluation Design Standards Facility Adaptation Facility Sustainability Realisation of Affordance Occupancy Adaptation Quality Indicators User Adaptability Cost Efficiency Evaluation Occupancy Evaluation Facility Reconfiguration Technical Provision Evaluation Spatial Optimisation Professional Re-imagining Future Proofing Operational Refinement Project Management Operational Alignment

Comment - The scores used for this analysis were the average of "extremely significant" responses from all respondents across all four phases of the proposed framework. The scores for factors range from 92% extremely significant (Education Principles) to 22% extremely significant (Operational Alignment).

The patterns shown in this analysis identify a clear spread of responses suggesting there is appropriate discrimination between factors from the high end of the ratings to factors at the low end of the ratings. The UCA identifies a high-end cluster of ten factors with an extremely significant rating of greater than 80% and a low-end cluster of 17 factors with an extremely significant rating of less than 41%. These factors are listed in Table 8.

Data set 2: all respondents "extremely significant" for phase 1
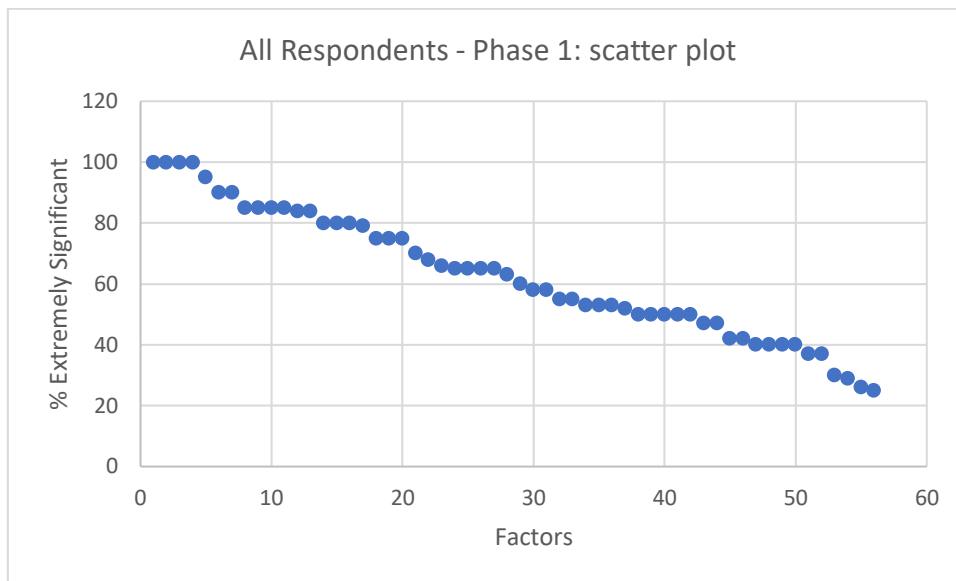

Figure 11: Scatter plot distribution of responses for all respondents rated extremely significant for phase 1.
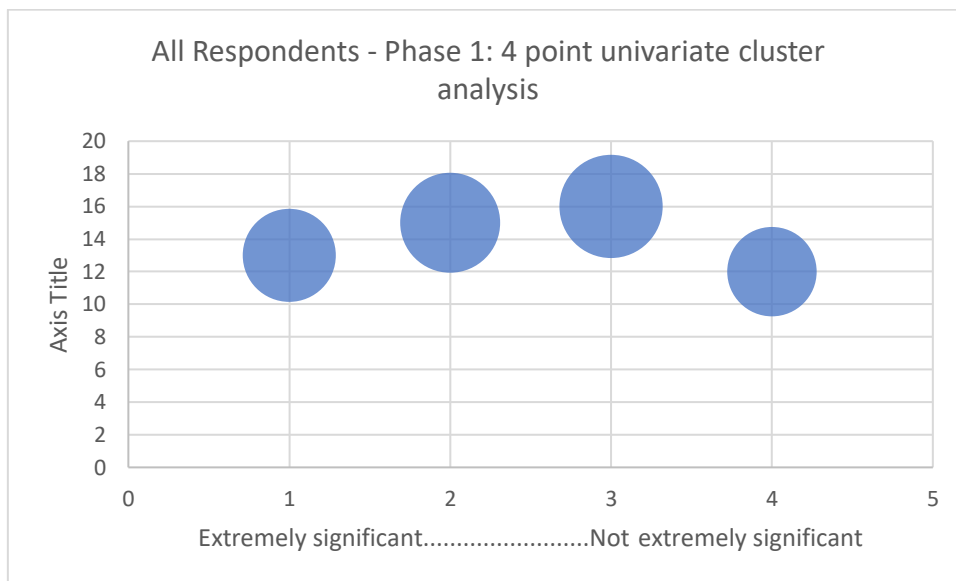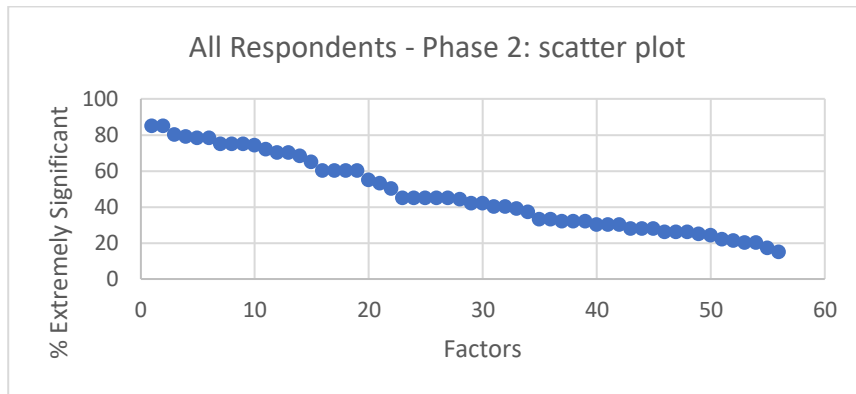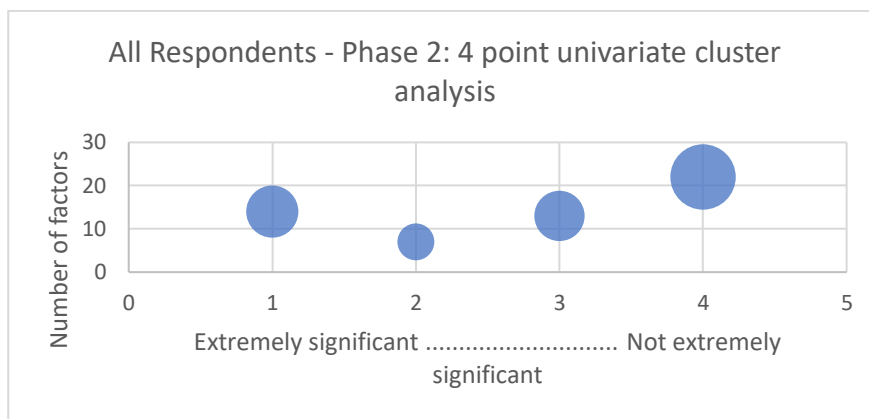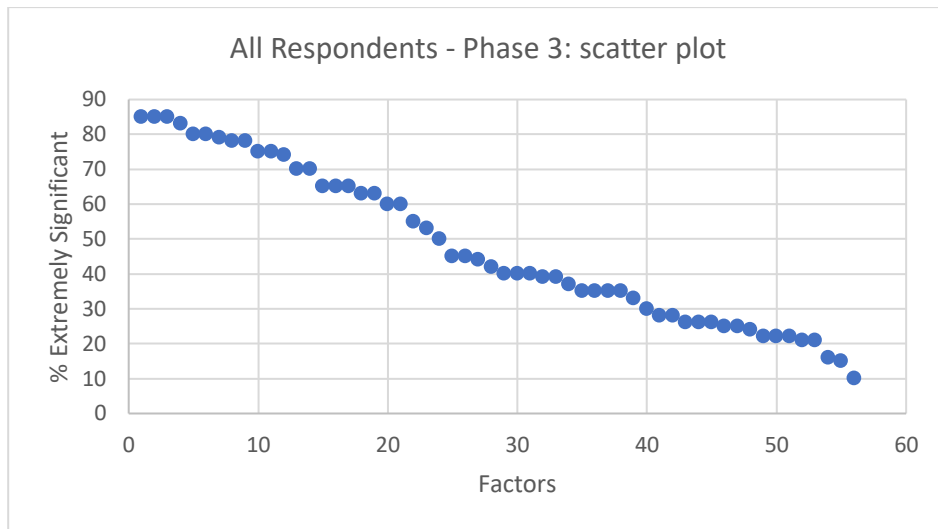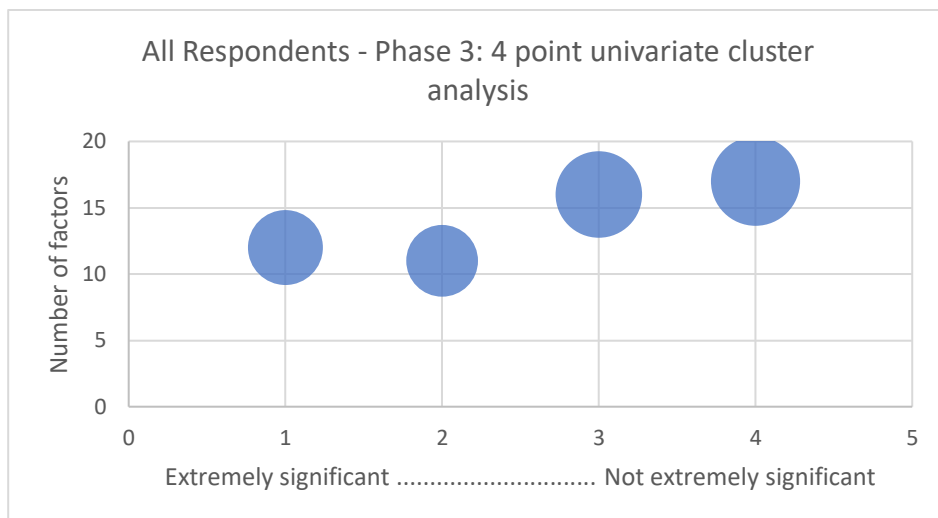

Figure 12: 4-point univariate cluster analysis of responses for all respondents rated extremely significant for phase 1.

Comment - The scores used for this analysis were the average of "extremely significant" responses for phase 1 of the proposed framework. The scores range from 100% extremely significant (Education Principles, Stakeholder Engagement & Teaching Approaches) to 26% extremely significant (Operational Alignment).

The factors show a similar distribution to the previous set, although the UCA identifies 13 factors in cluster 1 compared with 10 factors on average. This slight variation is shown to

have greater levels of volatility in the analysis of the separate response groups in subsequent analysis. Full lists of the factors identified in the clusters through the UCA are not presented for each of the separate phases. The consolidated list is presented in Table 14 and two figures highlighting points of comparison are presented at the end of the section.

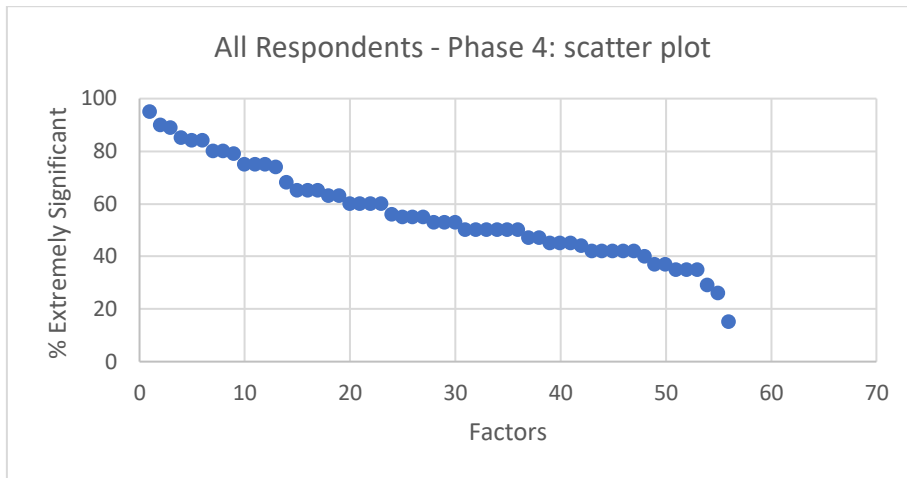**Data set 3: all respondents "extremely significant" for phase 2**

Figure 13: Scatter plot distribution of responses for all respondents rated extremely significant for phase 2.
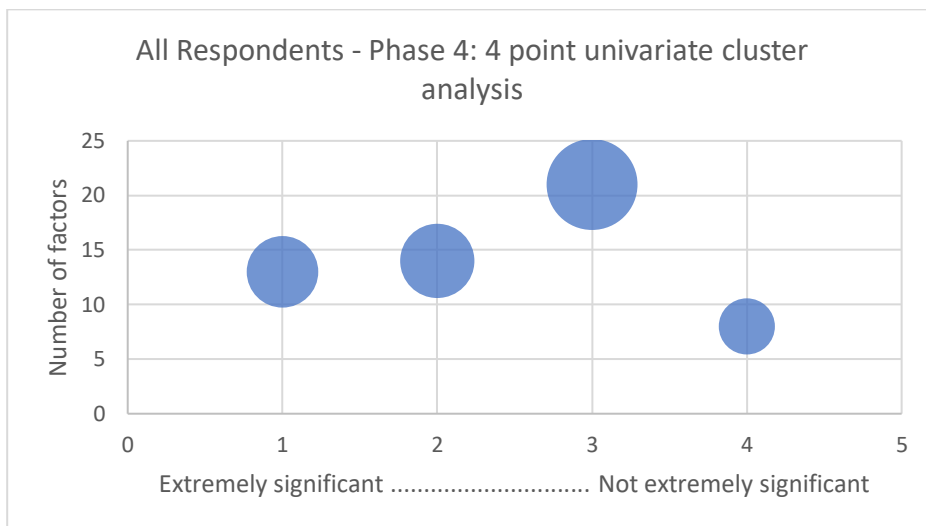

Figure 14: 4-point univariate cluster analysis of responses for all respondents rated extremely significant for phase 2.

Comment - The scores used for this analysis were the average of "extremely significant" responses for phase 2 of the proposed framework. The scores range from 85% extremely significant (Education Principles & Student Well-being) to 15% extremely significant (Future Proofing). The factors show a similar distribution to the previous sets, although the UCA identifies 22 factors in cluster 4 compared with 17 factors on average. This UCA grouping of 22 factors in cluster 4 is investigated further when considering the significance of the phases of the framework.

Data set 4: all respondents "extremely significant" for phase 3

Figure 15: Scatter plot distribution of responses for all respondents rated extremely significant for phase 3.

Figure 16: 4-point univariate cluster analysis of responses for all respondents rated extremely significant for phase 3.

Comment - The scores used for this analysis were the average of "extremely significant" responses for phase 3 of the proposed framework. The scores range from 85% extremely significant (Education Principles, Student Engagement & Teacher Capacity) to 10% extremely significant (Future Proofing). The factors show a similar distribution to the previous sets with 12 factors being identified in cluster 1 and 17 factors in cluster 4.

Data set 5: all respondents "extremely significant" for phase 4

Figure 17: Scatter plot distribution of responses for all respondents rated extremely significant for phase 4.

Figure 18: 4-point univariate cluster analysis of responses for all respondents rated extremely significant for phase 4.

Comment - The scores used for this analysis were the average of "extremely significant" responses for phase 4 of the proposed framework. The scores range from 95% extremely significant (Education Principles) to 15% extremely significant (Project Management).

The factors show a similar distribution to the previous sets, although UCA identifies the smallest grouping in cluster 4 with the largest group being identified in cluster 3.

Summary - This set of data analyses considered the responses in relation to the phases of the framework. The first set of data looked at the average of responses across all phases of the framework combined. Each single phase of the framework was then considered separately. The data indicates three key features with regard to the phases of the framework.

The ranking of factors, scatter plot diagrams and UCA groupings show consistent patterns across all data sets. These patterns indicate the ability to discriminate the factors along the ranking scale for the purpose of identifying those factors that architects and educators see as most significant.

There are two elements within these patterns, though, that need further consideration. While there is clear and consistent identification of the factors at the high end of the scale and low end of the scale, there is variation in rankings of factors in the middle areas of the scale, that is, in UCA clusters 2 and 3. Given this, it was not possible to say that the data sets analyses here provide a definitive answer to the original guiding question of *What factors do architects and educators see as most significant in the relationship between innovative learning environments and innovative education practices?*

Further, while there were clear and consistent patterns across the data sets for the average of all responses and responses for phase 1 of the framework, there were considerable variations to the patterns across phases 2, 3 and 4. This was especially so for the identification of factors within clusters 2 and 3 for these phases. Given this, it was not possible to say that the data sets analyses here provide a definitive answer to the original guiding question of *How should a framework be structured to best represent the identified factors?*

These findings are in line with the premise stated at the beginning of this chapter that the individual data sets will not provide definitive answers in their own right, but that all of the data sets will need to be considered in relation to each other to inform final decisions.

Data analysis by respondent groups

Table 9: Summary of data sets presented for analysis: Respondent Groups

Data set	Variable examined	Scatter plot	Univariate cluster analysis	Sorted list of factors	Comments
6. Architect respondents extremely significant for all phases	Architect group responses	X	X	X	X
7. Educator respondents extremely significant for all phases	Educator group responses	X	X	X	X
8. Comparison of architect and educator ratings of factors as extremely significant	Architect, educator and combined group responses	X		X	X

Purpose - This group of data sets identified the factors that were seen as most significant by the different respondent groups. This was an extension of the data analysis presented in the previous set where all responses were put together to form a single average. Data sets presented here looked at responses from the architect expert group and educator expert group separately. The purpose of this was to identify patterns of similarity and difference between the groups in identifying the most significant factors for the framework.

Data set 6: architect respondents "extremely significant" for all phases
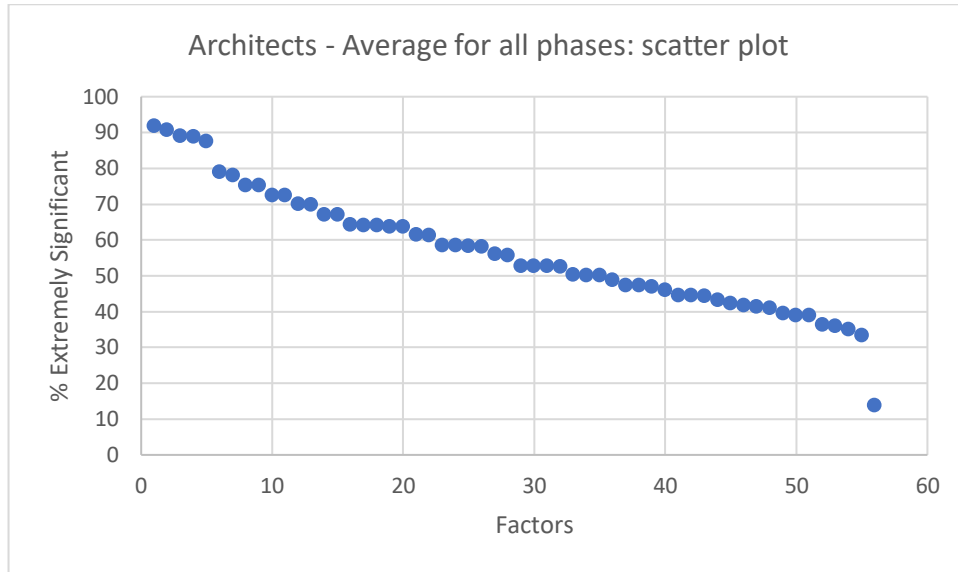

Figure 19: Scatter plot distribution of responses for architect respondents rated extremely significant for all phases.
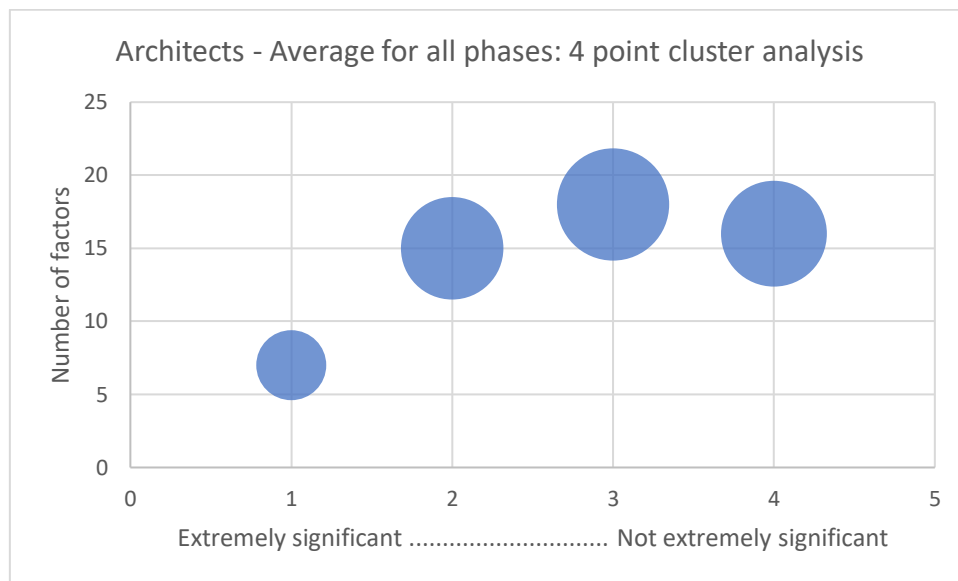

Figure 20: 4-point univariate cluster analysis of responses for architect respondents rated extremely significant for all phases.

Table 10: List of factors identified in clusters by 4-point univariate cluster analysis of responses for architect respondents rated extremely significant for all phases.

Factors Cluster 1 (7) High extremely significant	Factors Cluster 2 (15)	Factors Cluster 3 (18)	Factors Cluster 4 (16) Low extremely significant
Student Engagement Pedagogical Innovation Education Principles Teaching Approaches Learning Culture Student Voice Learning Styles	Collaborative Learning Inquiry Learning Professional Engagement Student Well-being Stakeholder Buy-in Stakeholder Engagement Virtual Learning Professional Practice Teacher Capacity Learning Activities Spatial Innovation Social Milieu Stakeholder Consultation Pedagogical Flexibility Professional Learning	Integrated Technology Realisation of Affordance Student Ownership Facility Viability Learning Connections Spatial Awareness School Identity School Operations Teaching Programs Furniture Function Evaluation Developmental Leadership Design Brief Professional Re-imagining Future Learning Flexible Design Operational Refinement Community Context Facility Adaptation	Facility Sustainability Spatial Optimisation User Adaptability Facility Reconfiguration Building Performance Evaluation User Comfort Evaluation Student Achievement Operational Alignment Occupancy Evaluation Occupancy Adaptation Quality Indicators Cost Efficiency Evaluation Design Standards Technical Provision Evaluation Future Proofing Project Management

Comment - The scores used for this analysis were the average of "extremely significant" responses from architect respondents across all four phases of the proposed framework. The scores ranged from 92% extremely significant (Student Engagement) to 13% extremely significant (Project Management).

The scatter plot diagram indicated that the 7 factors identified in cluster 1 sit reasonably differentiated from the following factors. This cluster grouping suggests a strongly agreed focus on the identified factors in the "high extremely significant" cluster by the architect respondents. These factors are listed in the first column of Table 10.

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Data set 7: educator respondents "extremely significant" for all phases
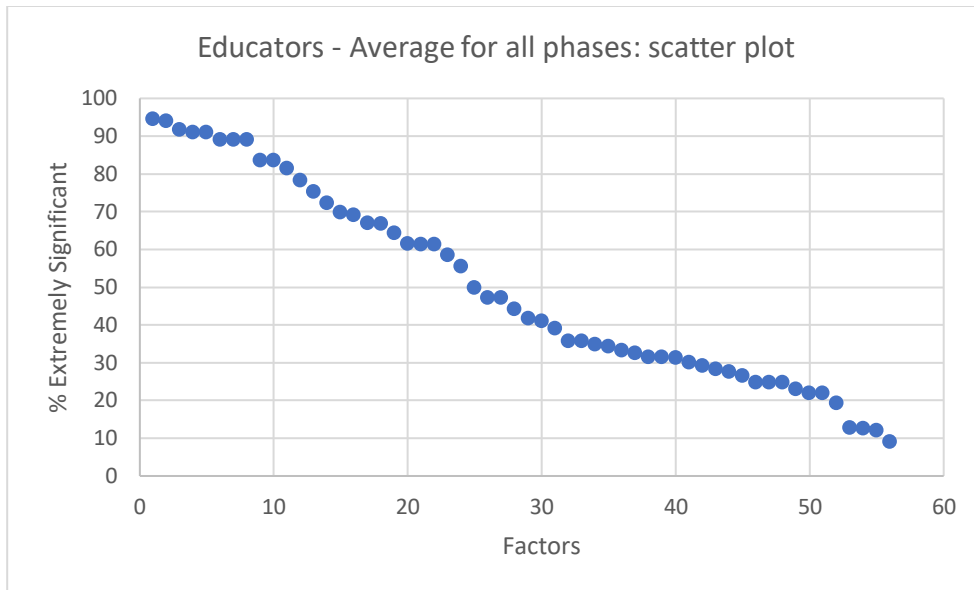

Figure 21: Scatter plot distribution of responses for educator respondents rated extremely significant for all phases.
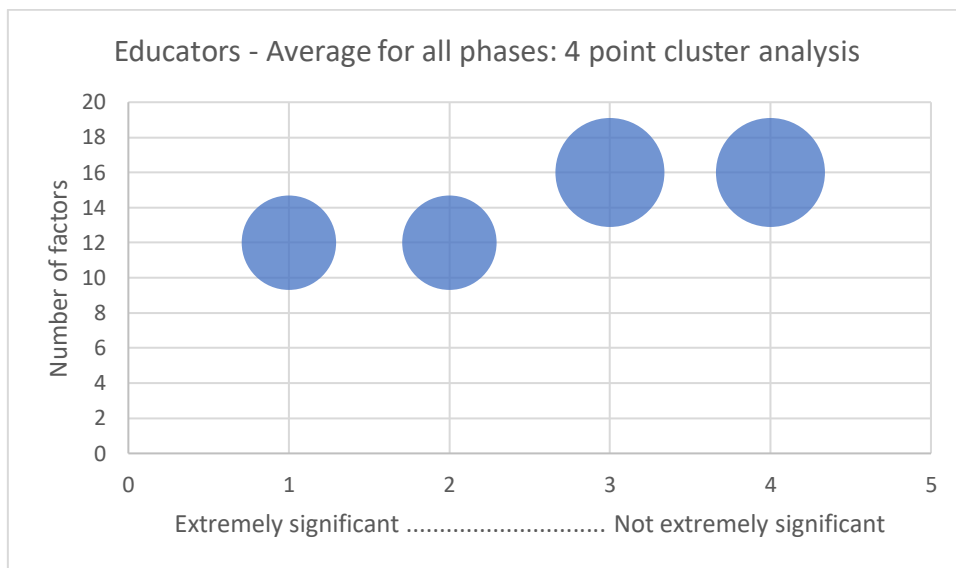

Figure 22: 4-point univariate cluster analysis of responses for educator respondents rated extremely significant for all phases.

Table 11: List of factors identified in clusters by 4-point univariate cluster analysis of responses for educator respondents rated extremely significant for all phases.

Factors Cluster 1 (12) High extremely significant	Factors Cluster 2 (12)	Factors Cluster 3 (16)	Factors Cluster 4 (16) Low extremely significant
Stakeholder Engagement Student Ownership Education Principles Student Voice Learning Culture Integrated Technology Student Engagement Student Well-being Teaching Approaches Professional Engagement Professional Practice Pedagogical Innovation	Pedagogical Flexibility Stakeholder Consultation Social Milieu Student Achievement Collaborative Learning Teacher Capacity Inquiry Learning Virtual Learning School Identity Stakeholder Buy-in Professional Learning Community Context	Learning Activities Learning Styles School Operations Flexible Design User Comfort Evaluation Learning Connections Design Standards Building Performance Evaluation Furniture Function Evaluation Facility Viability Future Learning Design Brief Cost Efficiency Evaluation Quality Indicators Developmental Leadership Occupancy Adaptation	Technical Provision Evaluation Facility Sustainability Spatial Optimisation Occupancy Evaluation Facility Adaptation Project Management User Adaptability Spatial Awareness Spatial Innovation Teaching Programs Facility Reconfiguration Future Proofing Professional Re-imagining Realisation of Affordance Operational Refinement Operational Alignment

Comment - The scores used for this analysis were the average of "extremely significant" responses from educator respondents across all four phases of the proposed framework. The scores ranged from 95% extremely significant (Stakeholder Engagement) to 9% extremely significant (Operational Alignment).

It is interesting to note here that the UCA identifies the same cut off point for cluster 1 for the analysis of architects and analysis educators (>78% extremely significant) and this formed a cluster of 7 factors for architects and 12 factors for educators. These factors identified as cluster 1 for the educators are listed in column 1 of Table 11.

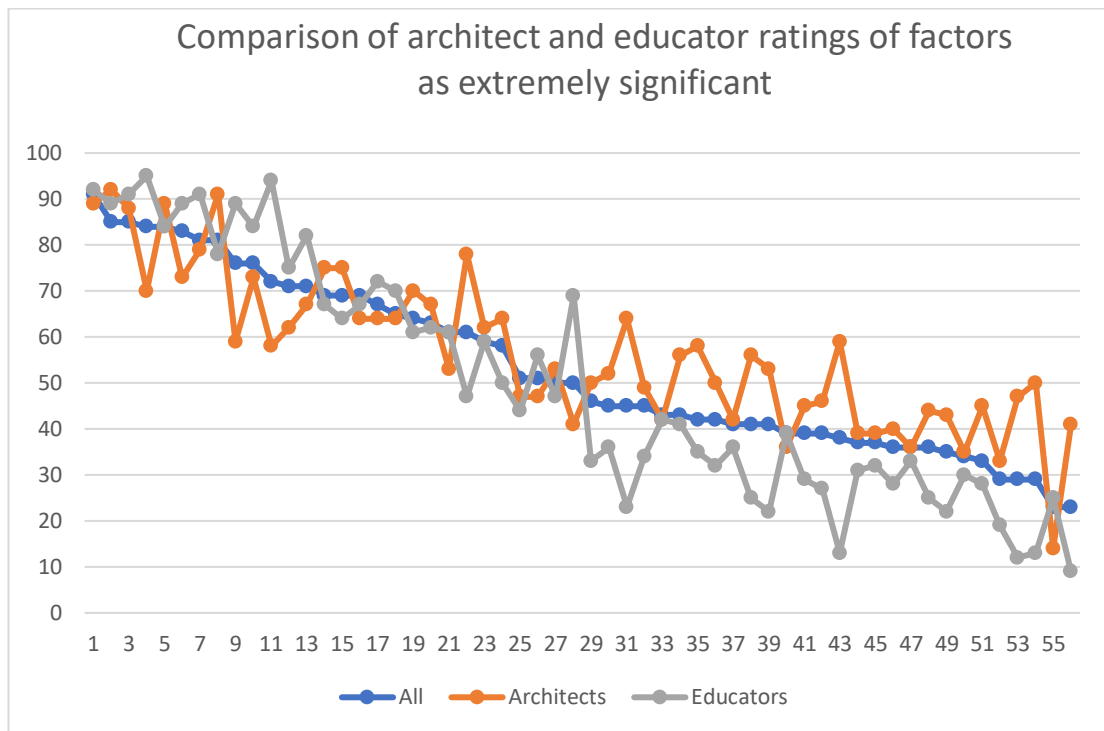**Data set 8: comparison of architect and educator ratings of factors as extremely significant**

Figure 23: A comparison of the scatter plot distributions of architect and educator ratings of factors as extremely significant.

Comment - Whilst the previous two data sets emphasised the overall similarities in the patterns of identifying factors as extremely significant when comparing the architects and the educators this data set highlights some of the points of difference within the data. These points of difference are around the ratings for individual factors. Figure 23 shows a scatter plot diagram where the rank order of the factors is determined by the overall average scores (blue line). The separate scores for the factors are shown for the architect respondents (orange line) and educator respondents (grey line). These scores show variations above and below the average line for individual factors.

There are a number of factors that could be said to have quite wide variations between the architect and educator ratings. Ten examples of this are identified and presented in Table 11.

Table 12: A list of factors highlighting different rating scores of extremely significant between architects and educators.

Factor rank order for average scores	Factor Label	Average rating extremely significant	Architect rating extremely significant	Educator rating extremely significant
5	Student Engagement	84	70	95
10	Integrated Technology	76	59	89

12	Student Ownership	72	58	94
23	Learning Styles	61	78	47
29	Student Achievement	50	41	69
32	Spatial Innovation	45	64	23
39	Spatial Awareness	41	56	25
40	Teaching Programs	41	53	22
44	Realisation of Affordance	38	59	13
55	Professional Re-imagining	29	50	13

There are key points to note when considering these variations in ratings between the architects and educators. In the first instance it must be emphasised that the ratings were derived from Likert-style scales and cannot be compared between the groups for statistical significance. Hence, it is not possible to say, for example, that the architects and educators have a significant difference of opinion on the significance of Student Engagement when the rating scores are 70 compared with 95. This data does provide for ranking scores that make for valid comparisons, though. In the data analysis presented previously UCA has been used to organise the factors into groups of reasonable similarity of rankings. Of the factors presented in the chart above where the rating scores suggest possible wide differences between the architects and educators, only five vary by being more than one cluster apart for the UCA groupings for the individual respondent sets. These factors are; Integrated Technology, Student Ownership, Learning Styles, Student Achievement and Spatial Innovation. The significance of these variations in informing both the nature of the proposed framework and the specific factors to be included is examined in detail in the following chapter.

Summary - The first two data sets presented here offered a comparison between the separate responses of architects and educators. The two data sets presented were the average responses across all phases of the framework. The separate data sets for the differentiated responses across all four phases of the framework were not presented here but were considered in the overall analysis of the data.

These data show two key features. In the first instance the architects and educators show a high level of agreement on the factors they identified as most significant, although the educators identify more factors as being extremely significant as indicated by cluster 1 in the UCA than the architects. Similarly, both groups show a high level of agreement on the factors they identified as low in significance indicated by cluster 4 in the UCA.

The third data set presented in Figure 23 is presented to highlight possible differences that might occur within the general pattern of agreement previously identified. There are some individual factors on which there seem to be considerable differences in the ratings of extremely significant between the architects and educators. These factors are identified in Table 12. It is suggested, however, that it is not possible to attribute statistical significance to these different ratings scores. Implications of these differences are considered in the qualitative context of making findings and recommendations arising from the data in the following chapter.

Data analysis using ratings of "not significant"

Purpose - The previous groups of data sets used responses of "extremely significant" as the indicator to score the rankings. Using this approach, the low-end rankings (cluster 4) were based on a low score for the positive attribute. The questionnaire also allowed for a response of "not significant at all". The following data sets attribute scores to the "not significant at all" responses to identify patterns that arise from this deliberately negative response. While there cannot be a statistical comparison between the factors that are rated "low extremely significant" and those rated "not significant at all" comparisons using ranked lists, scatter plot charts and UCA clusters can identify similarities and difference between the two forms of analysis. The comparisons can be particularly useful when making decisions about those factors that should be included or excluded in a revised set of factors for the framework.

Data set 9: all respondents "not significant at all" all phases
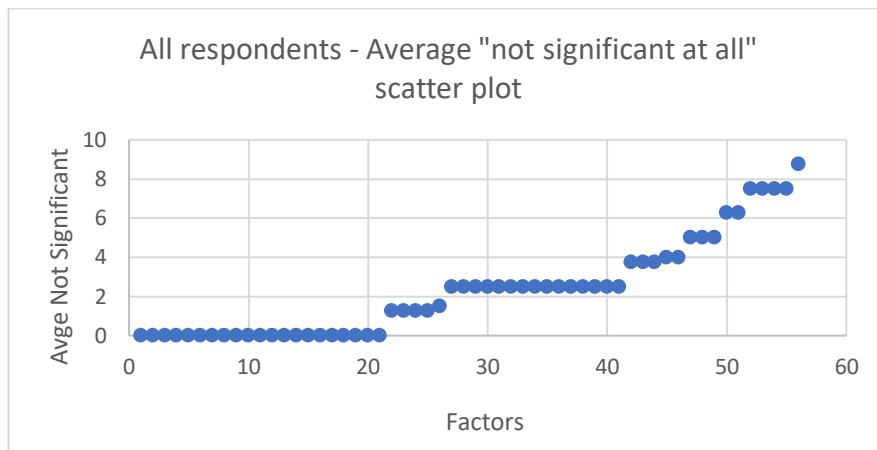
Figure 24: Scatter plot distribution of responses for all respondents rated not significant at all for all phases.
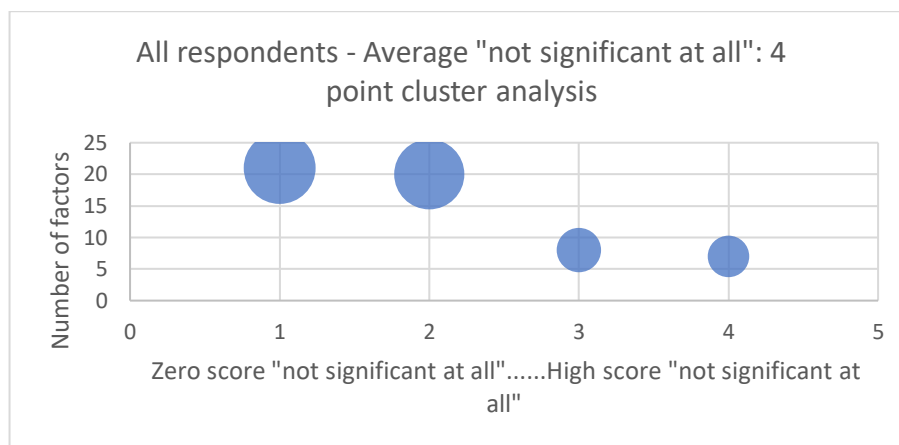
Figure 25: 4-point univariate cluster analysis of responses for all respondents rated not significant at all for all phases.

Table 13: List of factors identified in clusters by 4-point univariate cluster analysis of responses for all respondents rated not significant at all for all phases.

Factors Cluster 1 (21) Low score "not significant at all"	Factors Cluster 2 (20)	Factors Cluster 3 (8)	Factors Cluster 4 (7) High score "not significant at all"
Flexible Design Integrated Technology Education Principles Stakeholder Engagement Collaborative Learning Virtual Learning School Operations Teacher Capacity Teaching Programs Student Well-being Operational Refinement Occupancy Adaptation Stakeholder Consultation Pedagogical Flexibility Spatial Optimisation Professional Practice Operational Alignment Student Voice Learning Connections Pedagogical Innovation Learning Culture	Student Ownership Facility Adaptation Facility Reconfiguration Professional Re-imagining Social Milieu Future Proofing Design Standards Design Brief Community Context School Identity Teaching Approaches Learning Styles Furniture Function Evaluation User Comfort Evaluation User Adaptability Stakeholder Buy-in Professional Engagement Student Engagement Learning Activities Future Learning	Professional Learning Inquiry Learning Technical Provision Evaluation Facility Sustainability Spatial Innovation Realisation of Affordance Facility Viability Developmental Leadership	Quality Indicators Student Achievement Project Management Occupancy Evaluation Building Performance Evaluation Cost Efficiency Evaluation Spatial Awareness

Comment - The analysis presented here used distributions based on the scores of extremely significant. This means that the low-end clusters (cluster 4) were identified through lower scores of extremely significant. The questionnaire also allowed for a response of "not significant at all". These data sets attribute scores to "not significant at all" responses to identify the patterns that arise from this deliberately negative response, to be differentiated from the patterns that arose from the low-end positive response (i.e. low % "extremely significant").

This data is useful in identifying the most frequently identified not significant factors. UCA identifies two small clusters (clusters 3 & 4) that could be factors that are considered as the least significant.

These various analyses of the data have been used to develop a list of factors in rank order. The rank order determined here best represents the combined ratings of all respondents to identify the factors in order of significance in relation to the implementation of innovative education programs in innovative learning environments. Examination of the data for a series of variables (the different respondent groups and the different phases of the framework) shows very similar patterns of rankings across all variables. Since the data from the Likert-style responses to the questionnaire only has value for determining the ordering of the ranked items it is not possible to conduct tests of statistical significance for comparing the different response groups. Decisions about what the most valid order for the factors on a list is, and what factors could be included in or excluded from subsequent sets are qualitative decisions that need to be made with reference to the original research question.

Such decisions are explored in detail in the next chapter as a part of the discussion of the findings and recommendations of this research.

Analysis of the data with reference to the structure of the framework

The phases of the framework – Design, Transition, Consolidation, Re-appraisal – were considered fundamental to the structure of the framework in the initial phase of Conceptual Modelling. The phases are deliberately included in the framework to help address the issue that the implementation and evaluation of innovation in learning environments is an ongoing activity rather than just a singular event.

There was no direct question asking for a response to the significance of the phases, and even though there was opportunity for optional comment there was no comment provided on the nature of the phases. The structure of the questionnaire gave respondents the opportunity to identify which phase(s) of the framework they thought were most appropriate for considering the implementation of each factor. This section analyses the pattern of the degree of significance that respondents attached to the factors across the separate phases to see if any issue about the phases can be identified.

The data that was used here is identifying the factors that more than 75% of respondents identified as extremely significant for each of the phases. To help make the discussion more fluent through this section I have describe the factors identified using the >75% extremely significant score as the "most significant" factors. It is recognised that using such a selection is an arbitrary judgement and can only provide indicative results rather than definitive outcomes.

In the previous section clusters of factors were formed using univariate cluster analysis. These tended to have a delineation point at around the 80% mark for forming cluster 1. This mark was determined separately for each data set by the centroid established through the k-means cluster run. This 80% mark was used as an indicator for a cut-off point for the current data analysis. Analysis was also done using other combinations of "most significant" (>70%). The patterns of results were very similar for all sets of data.

The >75% criterion was chosen for this analysis as it provided a clear indication of the patterns being investigated with sufficient discrimination in the details and a sufficiently rich set of factors to provide for worthwhile analysis. Studying the data in this way provided some

interesting insights into the perceptions of the phases and also some subsequent insights into the nature of the lists of factors produced in the previous section.

The guiding question for this analysis is *How should a framework be structured to best represent the identified factors?* The analysis investigated how the respondents viewed the phases of the framework to consider if there is evidence suggesting that the phases should be changed, and if there is evidence proposing a particular way in which the factors should be represented in the phases of the framework.

Considering the phases of the framework

An initial way of determining how useful the respondents considered the phases is to look at how many factors they thought were most significant. The numbers are shown in the two table below.

Table 14: Number of factors rated "most significant" for the phases of the framework.

	Phase 1	Phase 2	Phase 3	Phase 4
Average	17	6	9	9
Architects	24	4	9	7
Educators	17	13	14	12

 (N.B. Average is the average % score for the combined ratings of all respondents.)

Table 15: Bar graph showing number of factors rated "most significant" for the phases of the framework.
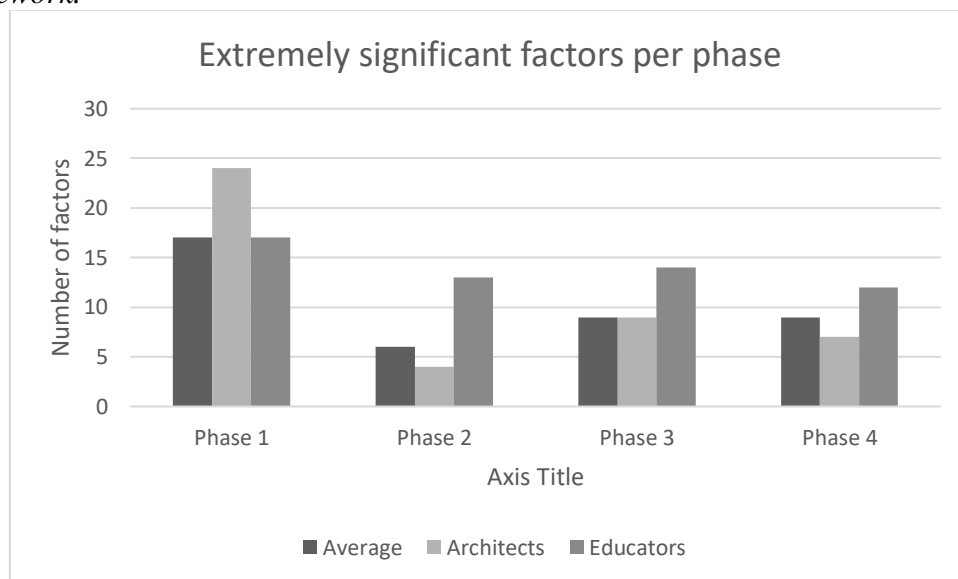
This data shows that there was the highest identification of most significant factors in phase 1 (Design). This was so for both architects and educators, but clearly more so for architects with 24 factors. There was the lowest overall identification of significant factors in phase 2 (Transition). This was more so for architects who identified only four factors as most significant for this phase while educators identified 13 factors using the cut-off criteria previously indicated.

The trends from this data suggest that architects were very highly engaged in the design phase of the framework in that they saw 24 factors as most significant at this phase, but much less engaged in the transition phase of the framework where they saw only 4 factors as most significant. Architects were then reasonably engaged in the consolidation and re-appraisal phases of the framework addressing 9 and 7 factors in these phases. It could be that phases 1,3 and 4 seem to align with the normal work flow of planning a project, POE for the project and planning for redeveloping the project from an architectural perspective. Whether this is a reasonable supposition is investigated further in the next section when I examine the nature of the factors that have been identified at each phase. A question to be considered arising from this is whether architects see phase 2 as sufficiently significant to be meaningful in the framework.

Educators seemed to be engaged quite evenly in all phases of the framework. There was peak engagement with 17 factors in the design phase, and then an even pattern of engagement with 13, 14 and 12 factors identified in the subsequent phases. This even spread of engagement with the phases of the framework by educators suggests they saw the phases as useful.

Studying the sets of factors that were identified as most significant in each of the phases gives an insight into what the respondents considered the key features of the phases. The sets of factors are presented in the following tables. The final column for each table contains those factors that gained the >75% most significant score on average across all of the phases. The factors identified in *italics* in the final column are those that were rated as most significant on average in all four phases of the framework for that response group.

Architects' views of the phases

Table 16: Factors rated extremely significant (>75%) for each phase by architects.

Phase 1 (n=24)	Phase 2 (n=4)	Phase 3 (n=9)	Phase 4 (n=7)	Average (n=9)
Pedagogical Innovation	Student Engagement	Student Engagement	Student Engagement	*Student Engagement*
Education Principles	Education Principles	Pedagogical Innovation	Pedagogical Innovation	*Education Principles*
Teaching Approaches	Teaching Approaches	Teaching Approaches	Education Principles	*Teaching Approaches*
Learning Culture	Professional Practice	Education Principles	Learning Culture	Pedagogical Innovation
Student Engagement		Learning Styles	Teaching Approaches	Learning Culture
Stakeholder Engagement		Professional Engagement	Student Voice	Student Voice
Social Milieu		Virtual Learning	Learning Styles	Learning Styles
Stakeholder Consultation		Professional Practice		Collaborative Learning
				Inquiry Learning

Student Voice School Identity Design Brief Flexible Design Community Context Learning Styles Professional Engagement Student Well- being Virtual Learning Learning Activities Spatial Innovation Professional Learning Integrated Technology Facility Viability Future Learning Design Standards		Teacher Capacity		

Comment - In Table 16 architects identify 24 factors as extremely significant in phase 1 of the framework. This might indicate a higher level of engagement with phase 1 compared with the subsequent phases where the respondents identify 4, 9 and 7 factors as extremely significant. There were two features of the factors identified in the phases above that are worth commenting on at this time. In looking across all of the phases there were three factors that the architects identify as extremely significant in all of the phases – student engagement, education principles and teaching approaches. These factors all have an orientation to higher order education issues. The architects identified a further four factors as extremely significant on average across all of the phases, although they were not identified in each individual phase. These factors were pedagogical innovation, learning culture, student voice, collaborative learning and inquiry learning. These were also factors that are distinctly education issues. In the extensive list of 24 factors that architects identify as extremely significant in phase 1 six could be considered to be more distinctly architectural in orientation – design brief, flexible design, spatial innovation, integrated technology, facility viability and design standards. It is interesting to note that the architects do not revisit these factors as extremely significant in a subsequent phase of the framework, for example phase 3 that I previously proposed may have had a POE orientation. I will explore the implications of these patterns for the structure of the framework in the analysis and recommendations presented in the following chapter.

Educators' views of the phases

Table 17: Factors rated extremely significant (>75%) for each phase by educators.

Phase 1 (n=17)	Phase 2 (n=13)	Phase 3 (n=14)	Phase 4 (n=12)	Average (n=13)
Stakeholder Engagement	Student Ownership	Stakeholder Engagement	Stakeholder Engagement	*Stakeholder Engagement*
Stakeholder Consultation	Student Voice	Student Ownership	Student Engagement	*Student Ownership*
Student Ownership	Student Well-being	Education Principles	Student Ownership	*Education Principles*
Education Principles	Stakeholder Engagement	Student Voice	Education Principles	*Student Voice*
Learning Culture	Education Principles	Learning Culture	Student Voice	*Learning Culture*
Student Well-being	Learning Culture	Integrated Technology	Learning Culture	*Integrated Technology*
Teaching Approaches	Integrated Technology	Student Engagement	Integrated Technology	*Student Engagement*
Student Voice	Professional Practice	Professional Engagement	Professional Engagement	*Student Well-being*
School Identity	Student Engagement	Pedagogical Innovation	Stakeholder Consultation	*Teaching Approaches*
Integrated Technology	Teaching Approaches	Pedagogical Flexibility	Student Well-being	*Professional Engagement*
Student Engagement	Professional Engagement	Teacher Capacity	Teaching Approaches	Professional Practice
Professional Practice	Social Milieu	Student Well-being	Stakeholder Buy-in	Pedagogical Innovation
Professional Engagement	Teacher Capacity	Teaching Approaches		Pedagogical Flexibility
Social Milieu		Collaborative Learning		
Inquiry Learning				
Virtual Learning				
Community Context				

Comment - Table 17 shows the factors that educators rated as extremely significant across the phases of the framework show patterns that are markedly different from the patterns previously identified for architects. While there was a similar inclination to peak engagement at phase 1 (17 factors for educators compared with 24 factors for architects) the educators showed a more even higher level of engagement with factors across all phases than architects. Educators identified 10 factors as extremely significant across all four phases of the framework suggesting an ongoing commitment to these factors throughout the life cycle of a project. Educators certainly had a focus on educational issues and do not identify a factor that could be considered distinctly architectural as extremely significant at any phase.

Combined respondents' views of the phases

While the presentations of the responses according to the two respondent groups in the previous two sections highlights the differences in their identification of extremely significant factors combining responses to calculate an average score derived from that total helps identify the commonalities in the pattern. In using an average in this manner, though, it is

acknowledged that the raw number of respondents was different for each of the groups and therefore the average values are skewed towards the educator group.

Table 18: Factors rated extremely significant (>75%) for each phase by architects and educators combined.

Phase 1 (n=17)	Phase 2 (n=6)	Phase 3 (n=9)	Phase 4 (n=9)	Average (n=10)
Stakeholder Engagement Stakeholder Consultation Student Ownership Education Principles Learning Culture Student Well-being Teaching Approaches Student Voice School Identity Integrated Technology Student Engagement Professional Engagement Social Milieu Inquiry Learning Pedagogical Innovation Community Context Flexible Design	Education Principles Learning Culture Student Well-being Student Voice Student Engagement Professional Practice	Education Principles Learning Culture Student Voice Student Engagement Teaching Approaches Pedagogical Innovation Pedagogical Flexibility Teacher Capacity	Education Principles Learning Culture Student Voice Student Engagement Teaching Approaches Pedagogical Innovation Stakeholder Engagement Student Well-being Student Ownership	*Education Principles Learning Culture Student Voice Student Engagement* Teaching Approaches Pedagogical Innovation Stakeholder Engagement Student Well-being Integrated Technology Professional Engagement

Comment - The table that presents the average of the combined scores of architects and educators has the effect of flattening the differences between the separate groups. The use of the average scores identified 17 factors in phase 1, and in doing this removed all but one of the distinctly architectural factors identified by the architects alone. The 10 factors identified as being extremely significant on average across all 4 phases strongly represents the same patterns as in the individual group data sets.

Summary

The tables presented above examined patterns of the data across the phases of the framework. The data indicated some differences in sets of factors identified as extremely significant at various phase of the framework between the two respondent groups. The data also indicated different numbers of factors identified as extremely significant at different phases of the framework by the two respondent groups. The implications of these patterns will be discussed

in the following chapter to analyse their significance for shaping a revised framework of factors for learning environment evaluation, and revised questionnaire to support the interpretation of this framework.

Conclusion

This chapter presented analyses of data to help inform responses to the two guiding questions presented at the beginning of the chapter. Three different processes were used to develop the data for analysis. In the first instance the Likert-type responses collected through the research questionnaire were used to form a series of rank order lists of data. Scatter plot diagrams were used to give a visual representation to these lists. Univariate cluster analysis was used to group the factors into clusters based on their distributions in the scatter plot diagrams. Eleven sets of data were presented and analysed looking at various combinations of the variables of different respondent groups and different phases of the framework for consideration of the perceived significance of the factors. Three sets of data were presented to examine how the different respondent groups viewed the phases of the framework.

The data sets show generally clear and consistent patterns in how the respondents view the significance of the factors in relation to the implementation of innovative education programs in innovative learning environments. The ways in which this data is interpreted to make recommendations about the factors that should be included in a framework and how the framework should be presented are presented in the next chapter. This leads to a subsequent consideration of the questionnaire used to support user interpretation of the framework.

Chapter 6: Discussion of Findings and Recommendations

Introduction

The aim of this research was to develop a framework of factors that facilitates the evaluation of innovative education practices in innovative learning environments. The development of the framework is to help practitioners best identify their particular situation and circumstances for the evaluation of identified aspects of the relationship between learning environments, teaching and learning practices and learning outcomes. The framework is not intended to prescribe a particular profile of factors for a user group but to enable the development of a profile identified by the user group through their use of the research questionnaire. A profile developed in this pragmatic manner should help users identify the best approach to evaluation appropriate to their particular circumstances. The development of such an approach is based on the premise that better judgements about evaluation tools, techniques and methods will be made if people are able to tailor evaluation approaches to meet specific purposes and needs identified by the users.

This research had a pragmatic orientation based on the concept of research and evaluation reflecting each other derived from the work of Alkin & Taut (2003) and Carden & Alkin (2012). Alkin and Taut point out that research and evaluation proceed in a similar fashion, but for different purposes and uses. In the case of research the goal is generalizable knowledge that contributes to the body of knowledge in a particular field, whereas for evaluation the purpose is context specific with the knowledge being intended for use by a particular group of people in a particular setting at a particular point in time.

The findings and recommendations presented reflect these two lines of development. Attention is given to both the development of the framework as informed by the research data (research knowledge) and the development of the questionnaire informed by the application of the research data (evaluation knowledge).

Criteria for determining the findings

The nature of the research was model building, that is, the development of an appropriate framework. Such model building required qualitative judgements about the data collected through the research questionnaire. The mixed methods research approach using the specific methodology of Expert Elicitation had an orientation to qualitative analysis and interpretation to suit this purpose.

The data was collected using a Likert-type scale questionnaire. This means that the data only had ordinal (ranking) value. Cluster analysis was employed to identify patterns within the data. Univariate cluster analysis was used as it best satisfies the recommendation for identifying a median for central tendency when using descriptive statistics (Boone & Boone, 2012).

Such statistical processes, however, provided only indicative data. Refined interpretations of the data are qualitative judgements based on determined criteria. The criteria for judgements are directed by the research questions and supporting questions declared for this research.

These questions are stated here to make them apparent leading into the following statements of findings and recommendations.

Guiding questions:

1. How should a framework to facilitate the evaluation of innovative education practices in innovative learning environments be structured?
2. What factors should be included in a framework for the evaluation of innovative education practices in innovative learning environments?

Following from these guiding questions there were a series of more specific questions to inform the analysis and interpretation of data gathered through the Conceptual Modelling and Expert Elicitation research. It is considered appropriate to revise these questions at this point to make them more effective in helping interrogate the data as it has emerged through the previous stages of analysis. This is in line with the iterative nature of both Conceptual Modelling and Expert Elicitation. The revised questions are presented as follows:

- How should a framework to facilitate the evaluation of innovative education practices in innovative learning environments be structured?
- What factors should be included in a framework for the evaluation of innovative education practices in innovative learning environments?
- How can a framework for the evaluation of innovative education practices in innovative learning environments facilitate the selection and implementation of the most appropriate approaches to evaluation for identified situations in the field?

The first two guiding questions relate to each other iteratively: that is, determining the factors to include could shape the nature of the framework, and determining the nature of the framework could shape the factors to be included. Interpretation of the data suggested that it is more appropriate to consider the factors in the first instance and then relate findings from that to the consideration of the framework.

The third guiding question is considered after the findings on the factors and framework are presented.

Factors for the framework

What factors should be included in a framework for the evaluation of innovative education practices in innovative learning environments?

The relationship between innovative education practices and innovative learning environments is extremely complex. The literature review that provided the foundation for this research identified over 400 factors or issues that were seen as significant in this relationship. The development of the framework to underpin this research provided a set of criteria to identify 71 factors considered most appropriate to populate the framework. Testing of the initial questionnaire derived from this framework found that using these 71 factors in the manner that generated a questionnaire of 93 items was still too complex to reasonably expect people to engage with. Refinement of the questionnaire, particularly in the way it referred to the previously declared perspectives and time phases, reduced the number of factors included to 56 and the subsequent item set to 61 questions.

It is now possible to look at further refinement of the set of factors that could be included in the framework. If there is strong agreement on what factors respondents see as most significant, and least significant, then the number of factors included in the framework could be further reduced. The intention of doing this would be to make the framework as concise as possible, while still addressing the core issues of significance, and to make the subsequent research questionnaire as user-friendly as possible.

The previous chapter presented a range of summaries of the data according to different combinations of key variables. There were brief comments on some of the interesting aspects of the patterns apparent in the data presented. This section takes analysis of the data a step further in looking to deliberately address the research questions.

Identifying extremely significant factors

The questionnaire asked respondents to respond to the question for each factor giving a rating on a scale of extremely significant / moderately significant / slightly significant / not significant at all. Focussing on the response "extremely significant" can generate a list of factors in rank order of perceived significance. The ranking is determined by the percentage of respondents who identified the factor as extremely significant. Such lists based on responses from architect experts, education experts and all experts combined were presented in the previous chapter to show that the data produced clear patterns of discrimination between the factors seen as extremely significant, and that using univariate cluster analysis based on such rankings could provide consistent groupings of the factors. That analysis examined the patterns of the data, but not the detail of the content within those patterns; i.e. what actual factors were included in the different data sets.

This analysis examines the actual factors in the relevant data sets – rankings of extremely significant by architect experts, by educator experts and by all respondents. The comparisons that are used are based on the cluster groupings created through the univariate cluster analysis of those data sets. Such examination determines if the experts agree on the most significant factors and if a consolidated ranking list can be presented.

It is appropriate to note at this point that the analysis presented here does not look at responses for the separate phases of the framework. Is uses the combined responses across all phases. Analysis of responses in relation to the specific phases is presented when considering the nature of the framework.

The analysis of the groupings created through UCA presented in the previous chapter indicated very similar patterns in the groupings created for the different respondents sets. Table 19 shows the numerical summary for this.

Table 19: Numbers of factors identified in each cluster grouping by respondent sets.

	Factors in cluster 1 (High extremely significant)	Factors in cluster 2	Factors in cluster 3	Factors in cluster 4 (Low extremely significant)
Architects	7	15	18	16
Educators	12	12	16	16
Combined Average	10	13	15	17

This simple summary of the numbers of factors in each cluster identified across the range "high extremely significant" to "low extremely significant" shows quite similar patterns between the architect and educator groups. The table below shows how this is represented in the actual factors.

Table 20: List of factors in cluster groupings.

Factors Cluster 1 (10) High extremely significant	Factors Cluster 2 (13)	Factors Cluster 3 (15)	Factors Cluster 4 (18) Low extremely significant
Education Principles (1/1) Student Engagement (1/1) Learning Culture (1/1) Stakeholder Engagement (2/1) Teaching Approaches (1/1) Student Well-being (2/1) Student Voice (1/1) Pedagogical Innovation (1/1) Integrated Technology (3/1) Professional Engagement (2/1)	Student Ownership (3/1) Pedagogical Flexibility (2/2) Professional Practice (2/1) Collaborative Learning (2/2) Inquiry Learning (2/2) Teacher Capacity (2/2) Stakeholder Consultation (2/2) Social Milieu (2/2) Stakeholder Buy-in (2/2) Virtual Learning (2/2) School Identity (3/2) Learning Styles (1/3) Professional Learning (2/2)	Learning Activities (2/3) Flexible Design (3/3) Community Context (3/2) School Operations (3/3) Student Achievement (4/2) Design Brief (3/3) Spatial Innovation (2/4) Furniture Function Evaluation (3/3) Future Learning (3/3) Learning Connections 3/3) User Comfort Evaluation (4/3) Developmental Leadership (3/3) Facility Viability (3/3) Spatial Awareness (3/4) Teaching Programs (3/4)	Building Performance Evaluation (4/3) Design Standards (4/3) Facility Adaptation (3/4) Facility Sustainability (4/4) Realisation of Affordance (3/4) Occupancy Adaptation ((4/3) Quality Indicators ((4/3) User Adaptability (4/4) Cost Efficiency Evaluation (4/3) Occupancy Evaluation (4/4) Facility Reconfiguration (4/4) Technical Provision Evaluation (4/4) Spatial Optimisation (4/4) Professional Re-imagining (3/4) Future Proofing (4/4)

			Operational Refinement (3/4) Project Management (4/4) Operational Alignment (4/4)

Table 20 shows the factor groups calculated for the combined average scores for all respondents. The numbers in parenthesis after each factor indicate the factor group they were in for the architects and educators separately. The chart presented in this way gives an overview of the relative rankings of the factors according to UCA.

The following features of similarity and difference are shown in the table above:

- There are 6 factors located in the cluster 1 on average that are also placed in cluster 1 by both the architect and educator respondents separately: Education Principles, Student Engagement, Learning Culture, Teaching Approaches, Student Voice, Pedagogical Innovation.
- There are 3 factors located in cluster 1 on average that are placed in cluster 2 by the architect respondents: Stakeholder Engagement, Student Well-being, Professional Engagement.
- There is 1 factor located in cluster 1 on average that is placed in cluster 3 by the architect respondents: Integrated Technology.
- There are 9 factors located in the cluster 2 on average that are also placed in cluster 2 by both the architect and educator respondents separately: Pedagogical Flexibility, Collaborative Learning, Inquiry Learning, Teacher Capacity, Stakeholder Consultation, Social Milieu, Stakeholder Buy-in, Virtual Learning.
- There are 3 factors located in cluster 2 on average that are placed in cluster 1 by one of the respondent groups: Student Ownership, Professional Practice, Learning Styles.
- There are 3 factors located in cluster 2 on average that are placed in cluster 3 by one of the respondent groups: Student Ownership, School Identity, Learning Styles.
- There are 4 factors located in cluster 3 on average that are placed in cluster 2 by one of the respondent groups: Learning Activities, Community Context, Student Achievement, Spatial Innovation.
- There are 29 factors that are clearly identified as belonging exclusively in clusters 3 and 4.

The following conclusions are drawn from this analysis:

1. There was strong agreement amongst the respondents in identifying a set of 23 factors seen as highly significant.
2. There was strong agreement amongst the respondents in identifying a set of 29 factors that are seen as low in significance.
3. There were four factors for which there is mild disagreement about their overall significance.

Given that the purpose of this analysis was to identify a set of factors that could be considered most significant for including a framework to facilitate the evaluation of

innovative education practices in innovative learning environments it is proposed that at this stage such a set of factors include the 23 from point 1 above and the 4 from point 3.

Finding 1: The experts agree on the most significant factors in relation to the implementation of innovative education practices in innovative learning environments.

The list of factors proposed as a result of this finding is presented below. The numbers presented in this table are the percentage of respondents rating the factor as extremely significant combined for all phases of the framework.

Table 21: List of factors identified as highly significant.

Education Principles	91
Student Engagement	85
Learning Culture	85
Stakeholder Engagement	84
Teaching Approaches	84
Student Well-being	83
Student Voice	81
Pedagogical Innovation	81
Integrated Technology	76
Professional Engagement	76
Student Ownership	72
Pedagogical Flexibility	71
Professional Practice	71
Collaborative Learning	69
Inquiry Learning	69
Teacher Capacity	69
Stakeholder Consultation	67
Social Milieu	65
Stakeholder Buy-in	64
Virtual Learning	63
School Identity	61
Learning Styles	61
Professional Learning	59
Learning Activities	58
Community Context	51
Student Achievement	50
Spatial Innovation	46

Identifying not significant factors

Since the purpose of this analysis was to refine the set of factors that were seen as most appropriate for inclusion in the framework it was reasonable to consider directly what factors should be excluded. The following analysis identified a set of factors that were seen as least significant to the framework. These are compared with the factors that were eliminated by default in the previous analysis. This comparison is used to confirm judgements about what factors should be included and excluded in a revised set proposed for the framework.

The questionnaire asked respondents to respond to the question for each factor giving a rating on a scale of extremely significant / moderately significant / slightly significant / not significant at all. Factors considered to be not significant could be identified in two ways from this scale. The first set of factors identified were those that had a high score rating for the response "not significant at all". A second set of factors was identified through the rating of scoring lowly on "extremely significant". The two sets of data provided rank order lists of factors that were compared to identify similarities in the rankings provided by the different criteria. The lists were examined from the different respondent variables (all respondents combined, architect respondents and educator respondents) to identify similarities and differences in the patterns. If there was clear agreement on a set of factors seen as not significant through these processes then it would be reasonable to propose that these factors need no longer be included in the framework.

The table (Table 22) below shows the factors with scores provided for responses of "not significant at all". These scores are the average of all "not significant at all" responses provided across all phases of the framework. These scores should be considered quite crude indicators. The questionnaire did not ask respondents to deliberately identify factors they considered not significant so that ratings given may well be a default position rather than a deliberate score. The numerical value created by generating an average for scores across all phases may not be truly representative of intentions, either. The value does not take into account whether or not the same respondent considered a factor extremely significant at another phase from the one where it was rated as not significant at all.

Table 22: List of factors showing comparative ratings of "not significant".

Issue	Not significant ALL	Not significant ARCH	Not significant EDU
Flexible Design	0	0	0
Integrated Technology	0	0	0
Education Principles	0	0	0
Stakeholder Engagement	0	0	0
Collaborative Learning	0	0	0
Virtual Learning	0	0	0
School Operations	0	0	0
Teacher Capacity	0	0	0
Teaching Programs	0	0	0
Student Well-being	0	0	0
Operational Refinement	0	0	0
Occupancy Adaptation	0	0	0
Stakeholder Consultation	0	0	0
Pedagogical Flexibility	0	0	0
Spatial Optimisation	0	0	0
Professional Practice	0	0	0
Operational Alignment	0	0	0
Student Voice	0	0	0
Learning Connections	0	0	0
Pedagogical Innovation	0	0	0

Learning Culture	0	0	0
Student Ownership	1.25	3	0
Facility Adaptation	1.25	3	0
Facility Reconfiguration	1.25	3	0
Professional Re-imagining	1.25	0	3
Social Milieu	1.5	3	0
Future Proofing	2.5	5	0
Design Standards	2.5	5	0
Design Brief	2.5	5	0
Community Context	2.5	0	5
School Identity	2.5	0	5
Teaching Approaches	2.5	0	5
Learning Styles	2.5	0	5
Furniture Function Evaluation	2.5	0	5
User Comfort Evaluation	2.5	5	0
User Adaptability	2.5	0	5
Stakeholder Buy-in	2.5	0	5
Professional Engagement	2.5	0	5
Student Engagement	2.5	0	5
Learning Activities	2.5	0	5
Future Learning	2.5	0	6
Professional Learning	3.75	0	8
Inquiry Learning	3.75	0	8
Spatial Innovation	4	0	9
Developmental Leadership	5	0	12
Technical Provision Evaluation	3.75	3	5
Realisation of Affordance	5	6	6
Facility Viability	5	6	6
Facility Sustainability	4	6	3
Quality Indicators	6.25	3	12
Student Achievement	6.25	3	6
Project Management	7.5	11	5
Occupancy Evaluation	7.5	6	11
Building Performance Evaluation	7.5	9	8
Cost Efficiency Evaluation	7.5	5	5
Spatial Awareness	8.75	8	11

Despite these shortcomings the table does provide the following useful insights. All respondents (architects and educators) agreed in identifying 11 factors with a rating of not significant at all. These factors are the 11 presented at the bottom of the table.

The respondents showed a difference of opinion on a considerable number of factors with 24 factors being rated as not significant at all by only one of the groups and not the other.

There was considerable agreement amongst the respondents with 21 factors being not rated as not significant at all by any respondent at any point in the phases. This set of factors are the top 23 on the list below. 20 of these factors are in the list of factors identified as most significant previously. The one factor that is not on the list of most significant is Spatial Optimisation.

Table 22 identifies 11 factors that both groups of respondents that rate as not significant at all – indicated in italics at the bottom of the table. A further group of 24 factors were identified by one of the respondent groups as not significant at all. The purpose of this piece of analysis was to identify factors that were considered not significant to the framework with a view to removing them from the framework to help produce a more simplified version of the framework. Since the indicators used above were quite crude a further comparison was made with factors that were identified as scoring lowly on the rating of highly significant.

The analysis of extremely significant factors presented previously identified 15 factors in UCA cluster 3 and 18 factors in cluster 4, that is the clusters of low rankings for extremely significant. The following table presents a comparison of these factors with the factors identified with a rating of not significant at all

Table 23: List of factors considered not significant.

	Ave score - not significant at all	UCA cluster - low extremely significant
Spatial Awareness	8.75	3
Project Management	7.5	4
Occupancy Evaluation	7.5	4
Building Performance Evaluation	7.5	4
Cost Efficiency Evaluation	7.5	4
Quality Indicators	6.25	4
Student Achievement	6.25	3
Realisation of Affordance	5	4
Facility Viability	5	3
Developmental Leadership	5	3
Facility Sustainability	4	4
Spatial Innovation	4	3
Professional Learning	3.75	2
Inquiry Learning	3.75	2
Technical Provision Evaluation	3.75	4
Future Proofing	2.5	4
Design Standards	2.5	4
Design Brief	2.5	3
Community Context	2.5	3
School Identity	2.5	2
Teaching Approaches	2.5	1
Learning Styles	2.5	2
Furniture Function Evaluation	2.5	3
User Comfort Evaluation	2.5	3

User Adaptability	2.5	4
Stakeholder Buy-in	2.5	2
Professional Engagement	2.5	1
Student Engagement	2.5	1
Learning Activities	2.5	3
Future Learning	2.5	3
Social Milieu	1.5	2
Student Ownership	1.25	2
Facility Adaptation	1.25	4
Facility Reconfiguration	1.25	4
Professional Re-imagining	1.25	4

Table 23 shows that there was agreement in the rating of "not significant at all" and "low extremely significant" for 25 of the 33 factors presented. These factors registered a rating as "not significant at all" and were located in the lower two cluster groups for the UCA of "low extremely significant". There were 10 factors for which the rating of "not significant at all" did not correspond with the lower two clusters for the UCA of "low extremely significant".

Finding 2: The experts show reasonable agreement on the least significant factors in relation to the implementation of innovative education practices in innovative learning environments.

The following table presents those factors that the experts agree to be of low significance to the framework.

Table 24: Factors identified as not significant for the framework.

	Ave score - not significant at all	UCA cluster - low extremely significant
Spatial Awareness	8.75	3
Project Management	7.5	4
Occupancy Evaluation	7.5	4
Building Performance Evaluation	7.5	4
Cost Efficiency Evaluation	7.5	4
Quality Indicators	6.25	4
Student Achievement	6.25	3
Realisation of Affordance	5	4
Facility Viability	5	3
Developmental Leadership	5	3
Facility Sustainability	4	4
Spatial Innovation	4	3
Technical Provision Evaluation	3.75	4
Future Proofing	2.5	4

Design Standards	2.5	4
Design Brief	2.5	3
Community Context	2.5	3
Furniture Function Evaluation	2.5	3
User Comfort Evaluation	2.5	3
User Adaptability	2.5	4
Learning Activities	2.5	3
Future Learning	2.5	3
Facility Adaptation	1.25	4
Facility Reconfiguration	1.25	4
Professional Re-imagining	1.25	4

The following list in Table 24 presents those factors on which the experts show some degree of disagreement as to their low significance to the framework. Since these factors were located in the upper bracket of rankings for extremely significant it is proposed that they be retained in the framework at this stage.

Table 25: List of factors for which there was disagreement between respondent groups as to overall significance.

	Ave score - not significant at all	UCA cluster - low extremely significant
Professional Learning	3.75	2
Inquiry Learning	3.75	2
School Identity	2.5	2
Teaching Approaches	2.5	1
Learning Styles	2.5	2
Stakeholder Buy-in	2.5	2
Professional Engagement	2.5	1
Student Engagement	2.5	1
Social Milieu	1.5	2
Student Ownership	1.25	2

Proposing factors for the framework

The findings above suggested two issues for consideration in relation to the framework. Table 19 presents a list of 27 factors for which there is strong agreement that they are of high significance to the framework. Table 24 presents a list of 25 factors for which there is agreement that they are of low significance to the framework. Table 25 presents a list of 10 factors for which there is considerable disagreement as to their significance to the framework. The over-riding purpose of this analysis was to simplify the framework by identifying factors that should be clearly included or clearly excluded. The lists of factors identified here would be used as the basis for further decision making in the context of the nature of the framework

and any possible changes to the structure of the framework. In particular, these sets of factors would be investigated for how they have an impact on the phases as proposed in the initial framework, and how they have an impact on the perspectives as they were proposed in the original framework.

Structure of the framework

The original framework is presented here so it is available for immediate consideration in relation to the discussion that follows.
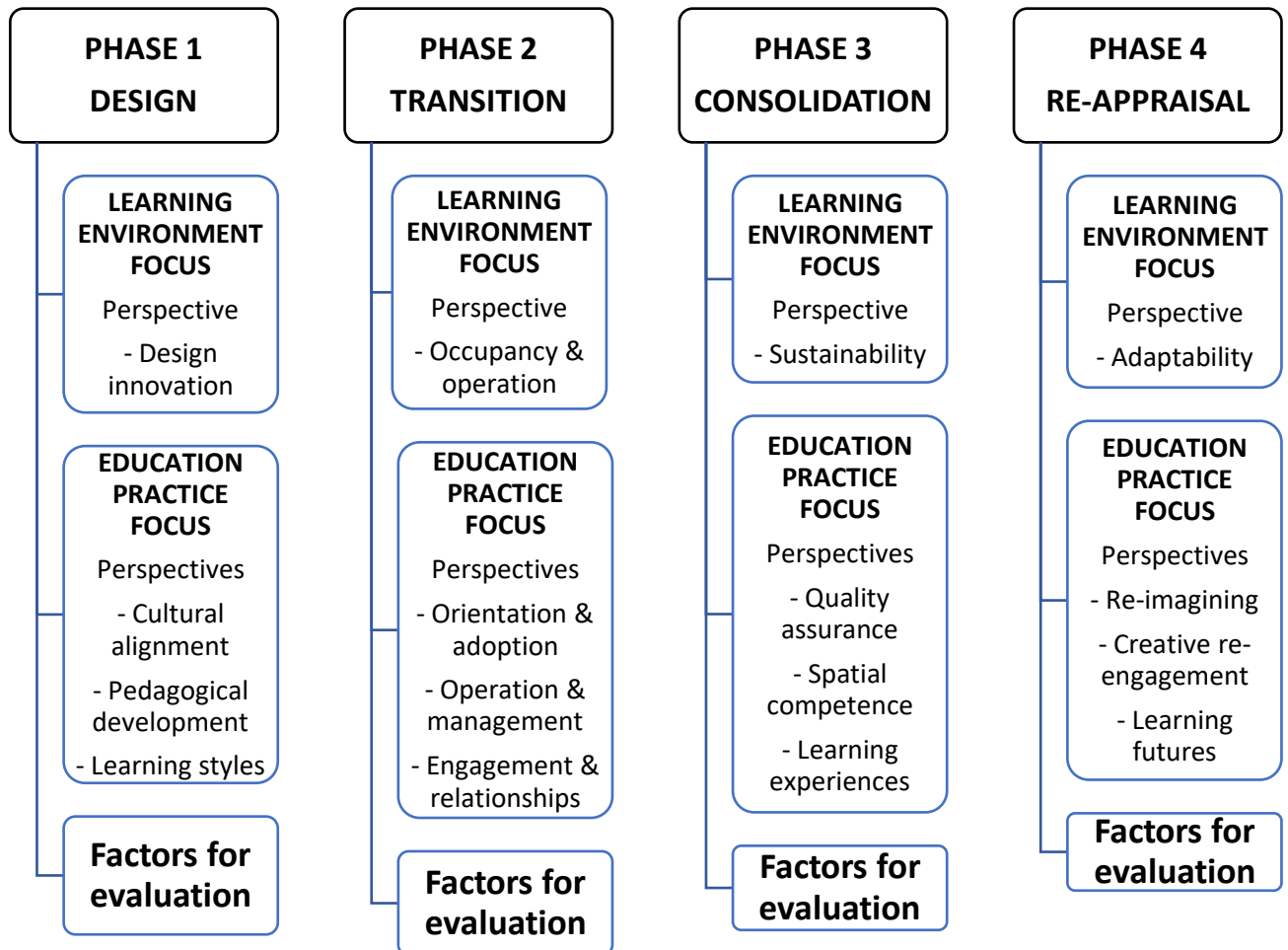
Figure 26: An overview of the framework of factors for learning environment evaluation.

The framework has two dimensions in that there is the horizontal dimension of the phases and the vertical dimension of the perspectives that lead to the identification of the factors. The factor lists identified above will be analysed in relation to the impact they have on the nature of each of these dimensions separately, and then examined collectively to consider impact on the overall structure of the framework.

Considering the factors in relation to the phases of the framework

When the identified significant factors are located in the framework in relation to the phases the following pattern is presented.
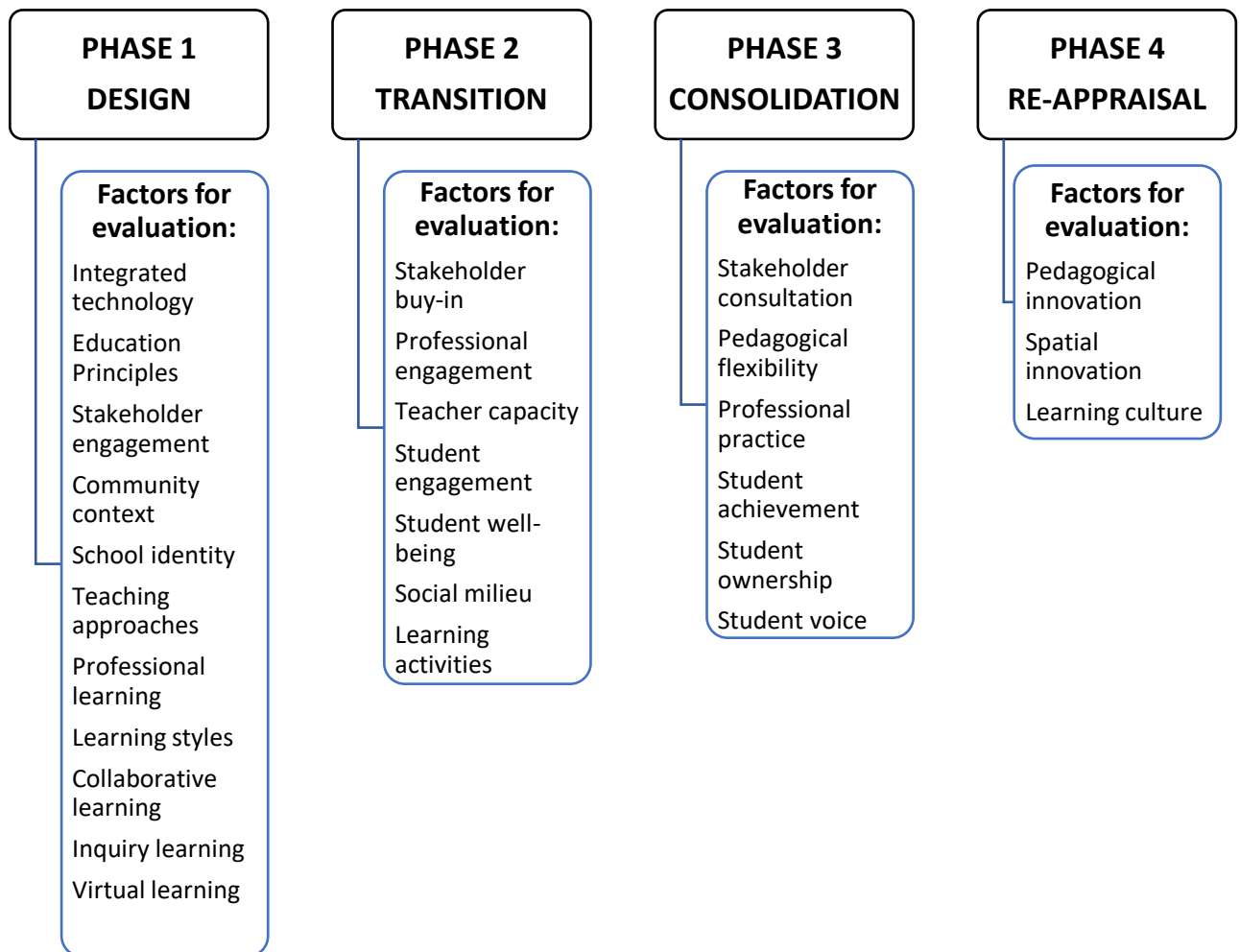
Figure 27: Significant factors located in the phases of the framework.

The pattern shown in the Figure 27 suggested the highest degree of engagement with the factors of significance occurred in Phase 1 with a pattern of reducing number of factors of significance through to Phase 4. It is important to note here that this location of the factors was not identified by the respondents through the questionnaire but was a mapping of the identified factors into their location on the original framework. The pattern was significantly different from the balanced metric of 18 factors in each phase proposed in the original framework.

Finding 3: The experts identify a substantially different balance of significant factors across the phases of the framework compared with the original proposal.

The implication of this finding was to consider if there was sufficient cause to change the nature of the phases in the structure of the framework. It was claimed in Chapter 3 that one of the key features of the framework for this research was the inclusion of the four phases. It

was shown how the phases were derived from the literature but seen as significantly different. This was in line with the Conceptual Modelling approach used for the development of the framework at that stage. The key points of reference for developing the four phases were described as follows: Johnson and Lomas (2005) presented a Conceive/Design/Implement/Operate (CDIO) model, while the Pedagogy/Space/Technology (PST) model presented by Radcliff et. al. (2008) used the same terminology (conception and design, and implementation and operation) but clumps them into two phases for their purposes. Lee and Tan (2008) proposed a three phase model of design, build, occupy in a constantly recurring cycle. The framework presented by Blackmore et el had a specific orientation to schools with four declared time phases (Design, Transition, Consolidation, Sustainability) (2012, p. 32).

The phases for the framework for this research were described as follows:

Phase 1 – Design – the period of planning the physical and educational features of the new learning environment facility. This would typically focus on sound architectural principles, contemporary educational philosophies and principles and concepts of best practice from both architectural and educational perspectives.

Phase 2 – Transition – the period of first occupation and use of the new learning environment facility. In this phase there is a focus on moving in to and occupying a new facility, organising services and resources necessary for the use of the facility and developing new organisational arrangements such as rules and protocols that will direct people's use of the facility.

Phase 3 – Consolidation – the period of implementing the ongoing education practices of the new learning environment facility. There is diversity of opinion as to how evaluation can best be implemented in this phase of the cycle as researchers move away from a deterministic premise that lends itself to traditional post occupancy evaluation approaches to a more socio-spatial approaches that emphasise qualitative studies of how the uses of learning environments change through a range of iterations over time.

Phase 4 – Re-appraisal – the period of exploring future options for the educational use of the learning environment facility. While most literature in the field suggests that this phase looks at sustainability of practices that have developed in the new learning environment, this model proposes that there could also be a desire to deliberately change these practices. Such change could involve consideration of the capacity of the facility to be reconfigured in some significant way, and for education practices to be changed in response to internal or external pressures.

It is reasonable to suggest that the experts did not engage with the factors presented in Phase 4, or the general concept of Phase 4 as a period for exploring future options for facility use. It is quite likely that the intended concept of phase 4 was seen as a continuity of the previous phases rather than a discrete entity.

When the factors identified in phases 2 and 3 were considered alongside each other it could be seen that there was considerable similarity between twelve of the thirteen factors: stakeholder buy-in compared with stakeholder consultation, professional engagement compared with professional practice, teacher capacity compared with pedagogical flexibility and a set of five factors that specifically refer to students – student engagement, student well-

being, student achievement, student ownership and student voice. Given this it was suggested that the respondents did not identify a significant difference between the phases of transition and consolidation as proposed in the framework. They have shown through their responses to the questionnaire that they identify a very similar pattern of factors across phases 2 and 3.

It is proposed from this that the four-phase framework originally presented as the basis for this research is more complex than is needed for the pragmatic use of the framework in the manner intended. There are two key concepts to the phases of the framework that need to be represented; a period of conceptualisation and planning, and a period of implementation and operation. This statement reflects exactly the terminology of the PST model of Radcliff et. al. and the CDIO model of Johnson and Lomas. Given this it is recommended that the time phases of the framework be simplified to two phases with the identified factors included in the manner indicated in the figure below.

PHASE 1
CONCEPTUALISATION
& DESIGN

Factors for evaluation:
Integrated technology
Education Principles
Stakeholder engagement
Community context
School identity
Teaching approaches
Professional learning
Learning styles
Collaborative learning
Inquiry learning
Virtual learning

PHASE 2
IMPLEMENTATION
& OPERATION

Factors for evaluation:
Stakeholder buy-in
Professional engagement
Teacher capacity
Student engagement
Student well-being
Social milieu
Learning activities
Stakeholder consultation
Pedagogical flexibility
Professional practice
Student achievement
Student ownership
Student voice
Pedagogical innovation
Spatial innovation
Learning culture

Figure 28: Significant factors located in a 2-phase framework.

The presentation of the framework above is the result of considering factors in relation to the horizontal dimension of the framework – the time phases. It is presented as a proposed idea at the moment, rather than a firm recommendation. This proposal will be further considered in the light of consideration of the factors in relation to the vertical dimension of the framework

– the perspectives. It will be an interaction of these two considerations that will result in any recommendations for final changes to the framework.

Considering the factors in relation to the perspectives of the framework

The purpose of the perspectives in the framework was to help refine the identification of factors for inclusion in the framework. The perspectives provided a further level of detail derived from the particular focus to which they are related. This was in line with following the processes of the Robinson approach to Conceptual Modelling as the initial phase of research as described in Chapter 3. The perspectives were considered a key feature of the framework and as such are significant in helping this research make an original contribution to the field. The conceptualisation of the perspectives is based on a pattern of one declared perspective for the learning environment focus at each phase and three perspectives for the education practice focus at each phase. The education practice perspectives are intended to represent the specific perspectives of education leaders (e.g. school principals), education practitioners (e.g. teachers) and education consumers (e.g. students).

The following tables present the set of factors identified as extremely significant in the previous section aligned with the pattern of perspectives.
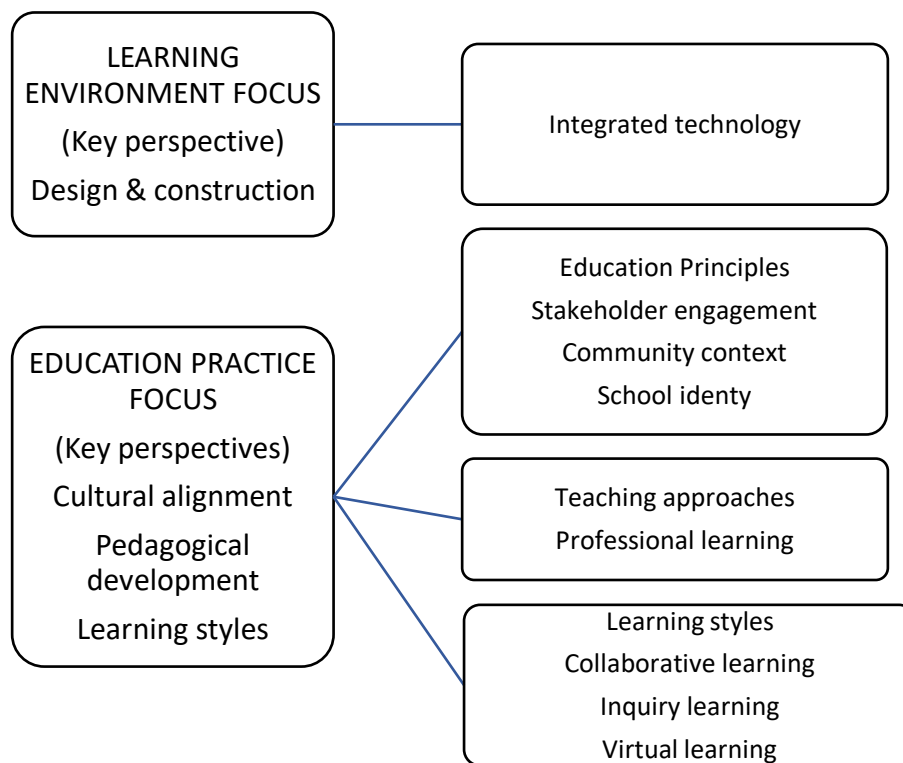
Figure 29: Significant factors aligned with the perspectives for Phase 1
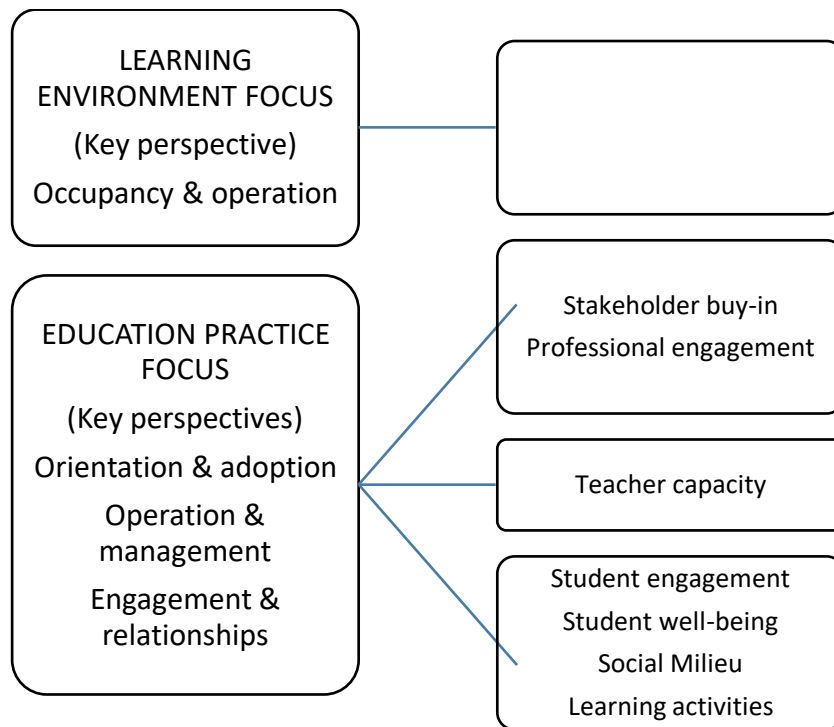
Figure 30: Significant factors aligned with the perspectives for Phase 2.
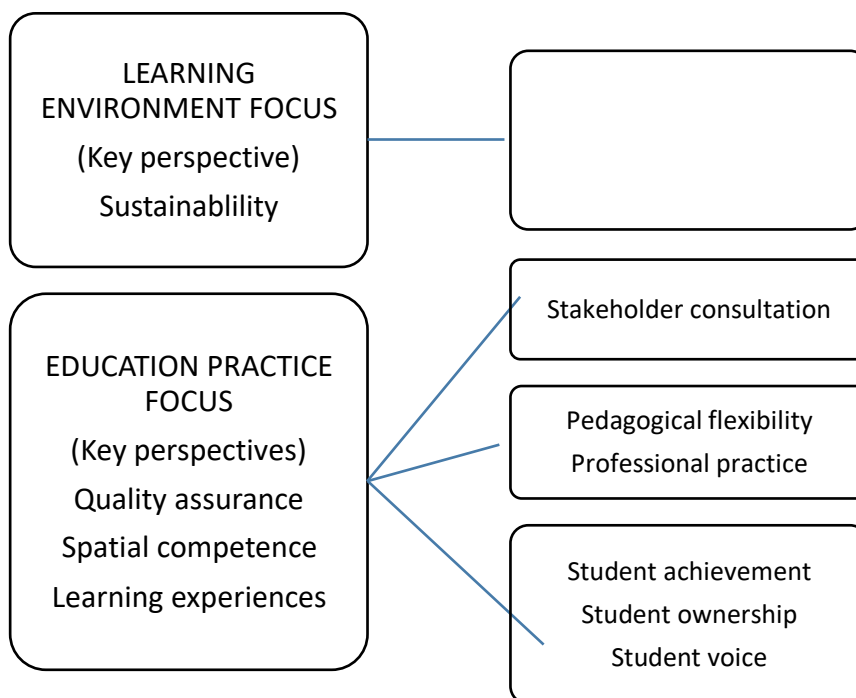
Figure 31: Significant factors aligned with the perspectives for Phase 3.

```
┌─────────────────────┐         ┌─────────────────────┐
│ LEARNING            │         │                     │
│ ENVIRONMENT FOCUS   │─────────│                     │
│ (Key perspective)   │         │                     │
│ Adaptability        │         │                     │
└─────────────────────┘         └─────────────────────┘

                                ┌─────────────────────┐
┌─────────────────────┐         │                     │
│ EDUCATION PRACTICE  │         │                     │
│ FOCUS               │         └─────────────────────┘
│ (Key perspectives)  │         ┌─────────────────────┐
│ Re-imagining        │         │ Pedagogical innovation
│ Creative re-        │         │ Spatial innovation  │
│ engagement          │         └─────────────────────┘
│ Learning futures    │         ┌─────────────────────┐
└─────────────────────┘         │                     │
                                │ Learning culture    │
                                │                     │
                                └─────────────────────┘
```
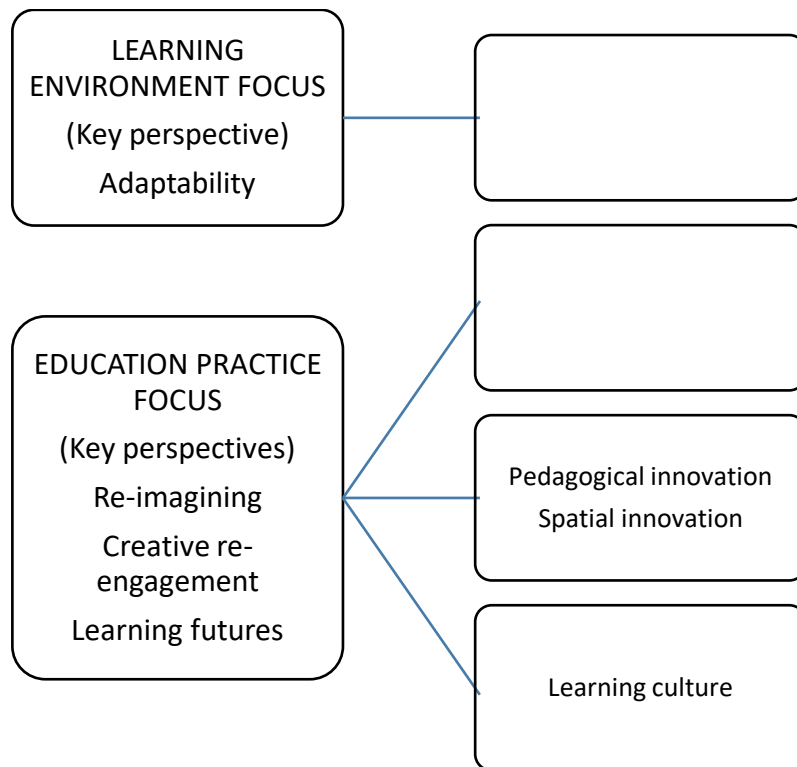
Figure 32: Significant factors aligned with the perspectives for Phase 4.

Patterns presented in the four figures above show three key features. The first is that there is only one factor from the Learning Environment Focus perspectives presented. This is a reduction from 12 factors suggested in the original framework. It is interesting to note that the one factor identified is "Integrated Technology" and this cannot be considered an exclusively learning environment factor.

A second pattern is the flow of factors representing the student perspective with a total of 12 in all from the original set of 16. This highlights the strong orientation to student related factors shown by all respondents throughout all of the data analysis.

A third pattern is the similarity of factors identified relating to the education leader and education practitioner perspectives. This is quite likely a reflection of the nature of the terms used in the original framework as much as specific interest in the factors. Since the perspectives were not presented in the questionnaire the respondents saw the factors as stand-alone terms without any particular contextualisation provided by the foci or perspectives. This suggests that while the foci and perspectives were important in shaping the initial conceptualisation of the framework, they were not important in informing the responses to the questionnaire. The contextual information (i.e. descriptions of the phases and foci) was provided as stand-alone documentation and therefore may not have been clearly related to the factors by the respondents as they worked through the questionnaire.

Finding 4: The research questionnaire did not provide strong contextualisation for understanding the nature of the terms presented.

A revised framework

Given the discussion above it is proposed that there be a revision of the original framework for the evaluation of innovative education practices in innovative learning environments. The revised framework addresses the following points:

There should be a reduced number of factors in the framework in line with findings 1and 2.

There should be a re-arrangement of the phases of the framework in line with finding 3.

There should be a manner for providing contextual meaning for the factors in line with finding 4.

A revised version of the framework is presented on the following page. The framework incorporates the following features that reflect the comments above.

1. The framework is presented on one page. This is an improvement on the previous version of the framework that was presented as multiple pages. Previously, the outline of the framework was presented as one page, the identification of the factors was presented as a separate page and there was a further page providing explanation of the phases.
2. The framework is presented with two phases. The phases are not labelled numerically but are given headings with descriptive statements. This reflects the analysis that the phases were not identified as significant in their own right in the previous framework. The stated intention of the framework is to support the concept of socio-spatial adaptation over time, and the new framework allows for this to happen in a fluid manner rather than trying to impose a rigid structure to the phases.
3. The framework contains guiding questions. This is a significant change from the original framework which set its sense of direction through the use of declared perspectives and foci. The guiding questions represent the intentions of the original perspectives and foci but present a form that encourages users to construct their own interpretations and priorities in relation to the framework. In doing this the guiding questions have a pragmatic orientation in that they do not prescribe certain perspectives on users but allow for interpretation appropriate to specific circumstances.
4. The framework presents two groups of key factors with 23 factors presented in all. These are the factors that were identified as most significant through analysis of the Expert Elicitation data. This compares with 56 factors presented in the previous framework. This set of factors is not seen as prescriptive in itself but forms the basis for a revised questionnaire that can be used to identify a specific set of factors seen as most significant to a particular user group.
5. The framework presents a statement making a connection to evaluation. There was no specific connection to evaluation made in the previous framework. The nature of this connection to evaluation is described in conjunction with the questionnaire. The revised questionnaire with comments is presented in Appendix 4.

A Framework of Factors for Learning Environment Evaluation (Revised)

CONCEPTUALISATION & DESIGN

(Planning the physical and educational features of a new learning environment facility. Engaging with innovative architectural concepts, contemporary educational philosophies and aspirational teaching and learning principles.)

IMPLEMENTATION & OPERATION

(Developing new organisational arrangements and new teaching and learning practices to support the optimal use of the new learning environment.)

GUIDING QUESTIONS

Does the design represent best practice in innovation in the field?

Does the design reflect the educational ambitions of the school?

Does the design foster the teaching and learning goals of the school?

GUIDING QUESTIONS

Are all users able to make best use of the new learning environment?

Are teachers able to operate optimally in the new learning environment?

Are the learning experiences of the students reflecting the learning intentions of the learning environment?

KEY FACTORS

Education principles

Stakeholder engagement

Community context

School identity

Teaching approaches

Professional learning

Integrated technology

Learning approaches

Collaborative learning

Inquiry learning

Virtual learning

KEY FACTORS

Stakeholder buy-in

Professional engagement

Pedagogical flexibility

Spatial innovation

Student engagement

Student well-being

Social milieu

Learning activities

Student achievement

Student ownership

Student voice

Learning culture

EVALUATION

What form of evaluation will best support the implementation of the learning environment project?

Evaluation tools, techniques and methods.

EVALUATION

What form of evaluation will best support the implementation of the learning environment project?

Evaluation tools, techniques and methods.

Figure 33: A framework of factors for learning environment evaluation (revised).

Comments on the revised framework

The initial part of the review of literature presented in Chapter 2 had a focus on literature with an architecture and design orientation. Figure 1 on p. 14 presented a summary of key terms derived from the literature that was examined. There are 40 terms presented in that figure. The terms were presented as indicative of terms used in the literature, rather than attempting to be an exhaustive list. It is interesting to note at this stage how these terms compare with the terms that have been identified as the key factors in the revised framework. None of the terms presented in Figure 1 exist in exactly the same form in the revised framework. There are strong similarities, however, in expressions around three key concepts.

Figure 1 included three terms that had an orientation to the connection between the school and its community – "community needs", "community in the school" and "multiple stakeholders". The revised framework includes three key factors that have a similar conceptual connection – "stakeholder engagement", "community context" and "stakeholder buy-in".

There can also be seen to be similarities around a group of terms that relate to the role of the teacher in a new learning environment between Figure 1 and the revised framework. Figure 1 included the term "evolving pedagogies" and "professional practice" while the revised framework has the key factors of "teaching approaches", "professional learning" and "professional engagement".

The greatest number of terms that have similarity between Figure 1 and the revised framework relate to learning. Figure 1 had the term "different approaches to learning" while the revised framework has a more generic term in "learning approaches". Figure 1 had three terms that identify specific approaches to learning in "problem-based learning", "collaborative" and "virtual groups". These are reflected in the revised framework through the key factors of "collaborative learning", "inquiry learning" and "virtual learning".

Figure 1 included the term "student centred" while the revised framework has much more specific detailing of this concept with the key factors of "student engagement", "student well-being", "student achievement", "student ownership" and "student voice".

The significance of this analysis is that while it shows substantial continuity of conceptual connection between the set of terms derived from the literature with an architectural perspective and those identified as most significant to include in the revised framework through the Expert Elicitation research there is subtle changing of exact terminology. This occurs because of the slightly changed context – the combined perspectives of architects and educators developed through the Expert Elicitation – and changes that happen in discourse over time.

The dynamic nature of the revised Framework of Factors for Learning Environment Evaluation addresses these issues in the following ways. The key factors are not presented as a stand-alone list, rather, they are offered for interpretation and refinement. Refinement can be done through the use of the accompanying questionnaire that can be used by a particular group. Guidelines for making decisions about refinement are given through the descriptions of the key purposes of the phases, the guiding questions and the nature of evaluation to be utilised. Thus, the key factors in the revised framework are able to be adapted to cater for different contextual settings, and differing interpretations of key ideas.

Revised questionnaire

The development of a revised questionnaire addresses Alkin and Taut's imperative to develop evaluation knowledge as well as research knowledge from this project. The revised questionnaire is an interpretation of the research finding of a revised framework of factors for learning environment evaluation.

The revised questionnaire follows the same template as the original questionnaire in that it asks respondents to rate their view of the significance of the presented factors in relation to the implementation of an innovative learning environment project. The revised questionnaire is significantly different in a number of ways based on interpretation and implementation of the research findings as presented in the revised framework.

The revised questionnaire has questions on the 23 factors included in the revised framework rather than the 56 factors presented in the original framework. When respondent identifier questions are included in the questionnaire (these could vary between three and five questions) it presents a total of 26 or 28 questions compared with 61 questions in the previous version.

The questionnaire is further simplified by addressing only two time phases as identified in the revised framework instead on the four phases of the original framework. In the original framework respondents could give significance ratings for the 56 factors presented for each of the four time phases. This would entail 224 response entries if done comprehensively. The revised questionnaire requires responses to the 23 factors in relation to two time phases requiring 56 response entries in total.

The wording of the questions in the revised questionnaire is changed from the original version to make a specific connection with evaluation. The original questionnaire asked respondents to identify the significance of the presented factors in relation to a learning environment development project. The purpose of the research through the original questionnaire was to identify a set of most significant factors from the extensive list presented. Linking the significance of evaluation with the identification of the factors in the original questionnaire would have created two complexities that were considered unnecessary at that time. It would have created two-part questions – identify significance of factors and identify significance of evaluation – which would have created a possible response requirement of 448 entries.

The original questionnaire achieved its primary purpose of identifying a set of most significant factors. The revised questionnaire has respondents specifically link these factors with evaluation. The outcome is that the revised questionnaire identifies those factors that are seen as most significant in needing to be considered in the evaluation of the implementation of innovative learning environment projects. The identification of these factors will not determine the nature of evaluation to be implemented per se but will point to some options for evaluation strategies and tools that could be used in the identified circumstances so that people can make the best possible informed choice on how to proceed from there.

This approach to developing a strategy for evaluation reflects the approach of Developmental Evaluation outlined in Chapter 3 and supports the ongoing implementation work of the Evaluating 21st Century Learning Environments project.

1. How significant do you think the evaluation of EDUCATION PRINCIPLES is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

2. How significant do you think the evaluation of STAKEHOLDER ENGAGEMENT is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

Figure 34: Sample questions from the revised questionnaire "Factors for Learning Environment Evaluation". (The full survey is presented as Appendix 4)

Conclusion

The aim of this research was to develop a framework of factors to facilitate the evaluation of innovative education practices in innovative learning environments. The purpose of the framework was to help practitioners best identify their particular situation and circumstances for evaluation of identified aspects of the relationship between learning environments, teaching and learning practices and learning outcomes. The need for such a framework was derived from the E21LE ARC project "Evaluating 21st Century Learning Environments". The development of the framework relates to the overarching research question of that 21LE project "How can we determine which learning environments best support 21st century pedagogies?".

The framework supports the development of a questionnaire that is a tool to help practitioners provide focus in particular situations and circumstances for evaluation. The research does not develop or identify a specific evaluation tool, technique, or approach but helps users identify what tool, technique or approach to evaluation from a suite being developed through the E21LE project would be most appropriate to their purposes.

The conceptual organisation and details of the framework developed for research were derived from a literature review deliberately incorporating a cross-disciplinary perspective of literature from a background in architecture and learning facility design, and a background in education practice with a particular orientation to teaching and learning in innovative learning environments. The framework was developed using a declared Conceptual Modelling approach.

The capacity of the framework to achieve its intended purposes was investigated through a research process of Expert Elicitation. The research methodology of Expert Elicitation was very effective in generating a valid pool of data from a small focussed group of respondents. Analysis of the data identified a series of issues that were addressed to produce a revised framework that would better reflect the overall intentions of the research and answer the research questions.

This research has achieved its aim of developing a framework of factors that facilitates the evaluation of innovative education practices in innovative learning environments. That framework is presented as Figure 33 on p. 103 of this thesis.

The research also addressed its guiding questions in informing the development of the framework. The research identified a particular structure to the framework developed initially through the literature review and then revised in the light of analysis of the research data. This structure to the framework reflects frameworks used in previous similar studies but presents a structure unique to this research.

The research was extremely powerful in identifying the most significant factors that should be included in the framework. The Expert Elicitation research clearly identified a set of 23 factors that are included in the revised framework as presented. The identified factors had a strong orientation to the concepts of education principles, stakeholder connection and student engagement. This set of factors provides a clear focus for architects and educators working together on the development and implementation of innovative education projects in innovative learning environments.

The revised questionnaire developed from the revised framework achieves the goal of providing a tool to facilitate the evaluation of innovative education practice in innovative learning environments.

Summary of findings, outcomes and recommendations

I have previously referred to Alkin and Taut's concept of the parallel development of research knowledge and evaluation knowledge in projects such as this. The primary purpose of this thesis was to develop research knowledge in relation to the research question. This is presented in the findings and actions below. The evaluation knowledge is developed through the pragmatic application of the demonstrated outcomes. The manner in how this could be developed is indicated through the recommendations presented below.

Finding 1: The experts agree on the most significant factors in relation to the implementation of innovative education practices in innovative learning environments.

Finding 2: The experts show reasonable agreement on the least significant factors in relation to the implementation of innovative education practices in innovative learning environments.

Finding 3: The experts identify a substantially different balance of significant factors across the phases of the framework compared with the original proposal.

Finding 4: The research questionnaire did not provide strong contextualisation for understanding the nature of the terms presented.

Outcome 1: A revised Framework of Factors for Learning Environment Evaluation was developed to address all of the above findings. This framework is presented on p. 102 of this thesis.

Outcome 2: A revised questionnaire to support the utilisation of the Framework of Factors for Learning Environment Evaluation was developed. This questionnaire is presented in Appendix 4.

Recommendation 1: That the revised Framework of Factors for Learning Environment Evaluation be promoted as a tool to help conceptual thinking for people involved in projects that are implementing innovative education practices in innovative learning environments. This could be done through the website for the Evaluating 21st Century Learning Environments project (www.e21le.com) and through the two professional associations who contributed expertise to the research in this study.

Recommendation 2: That the revised questionnaire be made available for people to use as a tool to identify a profile of significant factors in projects of implementing innovative education practices in innovative learning environments. This could be done in the same manner as described above for the framework.

Recommendation 3: That a tool to facilitate the interpretation of the questionnaire be developed based on the processes of analysis used in this study. This tool should be made available to accompany the use of the questionnaire.

Recommendation 4: That guidelines be developed to help people identify the most appropriate evaluation strategy and methodology to use in relation to the profile of significant factors they develop for their situation through their use of the questionnaire and analysis as indicated above. This could be done in association with the work of the Evaluating 21st Century Learning Environments project (www.e21le.com).

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Appendices

Appendix 1: Documents relating to the recruitment of respondents

Appendix 2: Summary of questionnaire distribution for Expert Elicitation

Appendix 3: Research Questionnaire

Appendix 4: Revised Research Questionnaire

Appendix 5: Summary of frameworks used in research

Appendix 1: Documents relating to the recruitment of respondents

1. Recruitment email
2. Plain Language Statement – Adults
3. Consent Form – Adults

1. Recruitment email

This is the text that was provided in the email inviting people to respond to the questionnaire.

Dear

I invite you to participate in the research project *Developing a model to facilitate the evaluation of innovative education practices in innovative learning environments.*

The research is being conducted by Graeme Oliver as a part of his Doctor of Education studies through the Melbourne Graduate School of Education.

You have been identified to participate in this project as you have high level expertise and experience in one or both of the relevant fields of study – architecture and education.

Your participation will require you to complete an online questionnaire accessed through the link at the bottom of this message.

Further information about the project and the questionnaire is provided in the attached documents:

Plain language statement

Consent form

Guidelines for taking the questionnaire

I hope that you will take the time to complete the questionnaire to support the data collection for this study. I thank you in advance for your time and effort.

Graeme Oliver
Doctoral Research Candidate
Melbourne Graduate School of Education
Graeme.oliver@unimelb.edu.au
(+61) 0421059469

2. Plain Language Statement – Adults

Plain language statement for adults

Project Title: Developing a model to facilitate the evaluation of innovative education practices in innovative learning environments

Dear _____

You are invited to participate in the research project named above. The project is being conducted by Graeme Oliver (Doctoral Research Candidate) in conjunction with the Evaluating 21st Century Learning Environments ARC project (www.e21le.com). The project is being jointly supervised by Associate Professor Wes Imms (Melbourne Graduate School of Education), Associate Professor Kenn Fisher and Dr Ben Cleveland (both Melbourne School of Architecture, Building and Planning). The project has been approved by the Human Research Ethics Committee in the Melbourne Graduate School of Education.

Project summary

The purpose of this project is to develop a model that will facilitate the evaluation of innovative education practices in innovative learning environments. The model will be used to inform planning, implementing and sustaining innovative education practices in innovative learning environments. The methodology for developing the model will be based on expert elicitation through Delphi Surveys which seek feedback from a wide range of experts in the field to build consensus on the critical issues that need to be addressed and strategies for addressing these issues. The research will engage with experts in both architecture and education.

The key research questions being asked are:

- What planning model can best support the evaluation of innovative learning practices in innovative learning environments?
- What trends typify innovation in learning environment design?
- Is innovation in learning environment design viewed in the same way by architects and educators?
- What can be identified as innovation in education practice?
- Is innovation in education practice viewed in the same way by architects and educators?
- How can we evaluate the relationships between innovative learning environments and innovative education practices in a manner that can inform sustained educational innovation in the context of innovative learning environments?

Data for the study will be collected through an online Delphi survey involving a targeted group of expert respondents.

Your involvement

Participants are asked to respond to an online questionnaire. The questionnaire contains questions relating to a series of issues identified in the model presented. Response to the questions is on a Likert type scale with the opportunity for personal comment. The questionnaire is presented in an interactive online form. It is not necessary to complete the entire questionnaire in one session, nor is it necessary for any participant to complete all of the questionnaire if they do not wish to do so. It is anticipated that completing the full questionnaire could take up to 60 minutes.

Data from the questionnaire will be analysed using cluster analysis techniques to identify the topics and issues that are seen as having the greatest significance to the relationship between innovative learning environments and innovative

education practices. Participants may be asked to respond to a second version of the questionnaire to help in further refinement of the model.

<u>Further information for all participants</u>

Participation in this study is completely voluntary. Should you wish to withdraw from the process at any time you are free to do so without any prejudice.

A list of participants will be presented in the appendix of the final report. This is intended to provide a profile of the scope and nature of the expertise that contributed to the data. Specific permission will be sought if participants are identified by name in the body of the report. If a participant wishes to have unprocessed data they have provided withdrawn from the report this will be done upon request.

All data collected through these research processes will be stored at the University of Melbourne in a locked filing cabinet and/or a password protected PC in accord with requirement of the University of Melbourne Policy on the Management of Research Data and Records.

Information gained through this research will contribute to the Doctor of Education of the researcher. Results will be published in his doctoral thesis, and in related papers and/or conference presentations. A summary of the research will be posted on the E21LE website. All participants will receive an email notification when publication is first made at www.e21le.com .

Should you require any further information, or have any concerns, please do not hesitate to contact Graeme Oliver (Doctoral Research Candidate) Melbourne Graduate School of Education, ph. 0421059469, email Graeme.oliver@unimelb.edu.au .

Should you have any concerns about the conduct of the research project, you are welcome to contact the Executive Officer, Human Research Ethics, The University of Melbourne, on ph.: 8344 2073, or fax: 9347 6739.

If you would like to participate in this research project please complete the questionnaire at the attached link.

Submission of the questionnaire will indicate your permission to participate in the project.

Graeme Oliver

Doctoral Research Candidate, MGSE

Graeme.oliver@unimelb.edu.au

0421059469

Research Supervisors

Associate Professor Wes Imms, Melbourne Graduate School of Education

Associate Professor Kenn Fisher, Architecture, Building & Planning, University of Melbourne

Dr Ben Cleveland, Architecture, Building & Planning, University of Melbourne

3. Consent Form – Adults

Consent form for adults participating in research project

Project Title: Developing a model to facilitate the evaluation of innovative education practices in innovative learning environments

Name of researcher: Graeme Oliver

1. *I consent to participate in the research project named above in order to assist with data collection. The project has been explained to me and I have read the Plain Language Statement. I understand that the project is for research purposes. I understand that the project involves investigating the factors that contribute to developing a model to facilitate the evaluation of innovative education practices in innovative learning environments.*

2. *I understand that my involvement requires responding to an online Delphi survey. Responding to the survey may take up to sixty minutes. I understand that I do not need to complete the entire survey, and that the survey does need to be completed in one session. I understand that I may be invited to participate in a second round of the survey.*

3. *I understand that the names of participants will be published in an appendix to the final report. I understand that responses from participants will only be referred to by pseudonym if mentioned in the body of the report or any associated publication. I understand that if I do not wish to be named in the list of participants then I can indicate this at the beginning of the survey.*

4. *I acknowledge that:*
   a. *I have read the written information (Plain Language Statement) about the project and have had the opportunity to clarify any information;*
   b. *I understand participation is voluntary and participants have the right to withdraw from the study at any time and that they may withdraw any data they have supplied (up to the point of analysis/publication);*
   c. *I am satisfied that the confidentiality of the information provided by participants will be safeguarded subject to any legal limitations.*

5. *I understand that I indicate my consent to participate in this research project through a specific response button at the beginning of the online survey*

Graeme Oliver
Doctoral Research Candidate, Melbourne Graduate School of Education
Research Supervisors
Associate Professor Wes Imms, Melbourne Graduate School of Education
Associate Professor Kenn Fisher, Architecture, Building & Planning, University of Melbourne
Dr Ben Cleveland, Architecture, Building & Planning, University of Melbourne

Appendix 2:   Summary of Questionnaire Distribution

Distribution Type	Source	Declared Expertise	Professional Background	Response Date
Weblink 1	Volunteer	Educator	School principal	1/16 (Trial)
Weblink 2	Volunteer	Educator	University academic	1/16 (Trial)
Weblink 3	Volunteer	Architect/Educator	University academic	1/16 (Trial)
Weblink 4	Volunteer	Educator	School principal	1/16 (Trial)
Weblink 5	Volunteer	Educator	School principal	1/16 (Trial)
Weblink 6	Volunteer	Architect	University academic	6/16 (Trial)
Weblink 7	Volunteer	Educator	School principal	Aug-16
Weblink 8	A4LE	Architect	Practice director	Sep-16
Weblink 9	APA	Educator	School principal	Nil
Weblink10	APA	Educator	School principal	Sep-16
Weblink 11	APA	Educator	School principal	Nil
Weblink 12	APA	Educator	School principal	Sep-16
Weblink 13	APA	Educator	School principal	Sep-16
Weblink 14	APA	Educator	School principal	Sep-16
Weblink 15	APA	Educator	School principal	Sep-16
Weblink 16	APA	Educator	School principal	Sep-16
Weblink 17	APA	Educator	School principal	Nil
Weblink 18	APA	Educator	School principal	Nil
Weblink 19	APA	Educator	School principal	Nil
Weblink 20	APA	Educator	School principal	Sep-16
Weblink 21	APA	Educator	School principal	Sep-16
Weblink 22	APA	Educator	School principal	Nil
Weblink 23	APA	Educator	School principal	Nil
Weblink 24	A4LE	Architect	Practice director	Nil
Weblink 25	A4LE	Architect	Practice director	Nov-16
Weblink 26	A4LE	Architect	Practice associate	Nov-16
Weblink 27	A4LE	Architect	Practice associate	Nov-16
Weblink 28	A4LE	Architect	Practice associate	Nil
Weblink 29	A4LE	Architect	Practice associate	Nov-16
Weblink 30	A4LE	Architect	Practice associate	Nil
Weblink 31	A4LE	Architect	Practice associate	Nil
Weblink 32	A4LE	Architect	Practice associate	Nov-16
Weblink 33	A4LE	Architect	Practice associate	Nov-16
Weblink 34	A4LE	Architect	Project manager	Nil
Weblink 35	A4LE	Architect	Project manager	Nov-16
Weblink 36	A4LE	Architect	Project manager	Nil
Weblink 37	A4LE	Architect	Practice associate	Nil
Weblink 38	Recommendation	Educator	Education Consultant	Nil
Weblink 39	Recommendation	Architect	Practice director	Nov-16
Weblink 40	Recommendation	Educator	School principal	Nov-16
Weblink 41	APA	Educator	School principal	Jan-17

| Weblink 42 | Recommendation | Educator | School principal | Jan-17 |
| Weblink 43 | Recommendation | Architect | University academic | Nil |

Appendix 3: Research Questionnaire

1. *Welcome to the questionnaire Issues in Learning Environments Evaluation*

Please complete the following questions to confirm your consent to participate in this project and to provide some expertise profile information.

1. I give my consent to participate in this research project.

◯ Give consent.

◯ Do not give consent

2. Please give your personal judgement of your level of expertise in the following category.

◯ Formal qualifications in architecture

or similar. ◯ No formal qualifications in

architecture.

3. Please give your personal judgement of your level of expertise in the following category.

◯ Professional/workplace experience in architecture

or similar. ◯ No formal professional/workplace

experience in architecture.

4. Please give your personal judgement of your level of expertise in the following category.

◯ Academic qualifications in education

or similar. ◯ No academic qualifications

in education.

5. Please give your personal judgement of your level of expertise in the following category.

◯ Professional/workplace experience in education

or similar. ◯ No professional/workplace experience

in education.

Issues in Learning Environments Evaluation

2. *Issues in Learning Environments Evaluation*

The body of the questionnaire asks you to give responses to 56 questions on issues relating to the development and implementation of innovative learning   environments.

You are asked to give your judgement on the degree of significance of the issues at the identified stages of a learning environment development and implementation   project.

The language of the questionnaire assumes a certain level of expertise by the respondents, but if you do not think that a question is clear or pertinent to your expertise then you do not need to respond.

You are welcome to make a comment in any of the comment boxes presented through the questionnaire.

Responses will be analysed to present a profile of the most significant issues relating to the development and implementation of innovative learning environment projects. This will be able to be done for different configurations of response groups.

The profiles of issues will help identify the most appropriate evaluation strategies to apply to the evaluation of innovative learning environment   projects.

The identified phases of an innovative learning environment development and implementation project are described as the following:

Phase 1 - DESIGN - the period of planning the physical and educational features of the new learning environment facility.

Phase 2 - TRANSITION - the period of first occupation and use of the new learning environment facility.

Phase 3 - CONSOLIDATION - the period of implementing the ongoing education practices of the new learning environment facility.

Phase 4 - RE-APPRAISAL - the period of exploring future options for the educational use of the learning environment facility.

6. Issue - *FLEXIBLE DESIGN*

How significant/important do you think it is to address the *principles of flexible design* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

7. Issue - *FUTURE PROOFING*

How significant/important do you think it is to address the *principles of future proofing* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

3

8. Issue - *DESIGN STANDARDS*

How significant/important do you think it is to address the *principles of design standards* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

9. Issue - *INTEGRATED TECHNOLOGY*

How significant/important do you think it is to address the incorporation of *integrated technology* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

4

10. Issue - *DESIGN BRIEF*

How significant/important do you think it is to address the *development of a design brief* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

11. Issue - *PROJECT MANAGEMENT*

How significant/important do you think it is to develop *a formal project management statement* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

5

12. Issue - *EDUCATION PRINCIPLES*

How significant/important do you think it is to develop an agreed statement of *education principles* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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13. Issue - *STAKEHOLDER ENGAGEMENT*

How significant/important do you think it is to address *stakeholder engagement* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

6

14. Issue - *COMMUNITY CONTEXT*

How significant/important you think it is to describe *community context* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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15. Issue - *SCHOOL IDENTITY*

How significant/important do you think it is to describe *school identity* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

7

16. Issue - *TEACHING APPROACHES*

How significant/important you think it is to describe *preferred teaching approaches* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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17. Issue - *PROFESSIONAL LEARNING*

How significant/important do you think it is to describe preferred *approaches to professional learning* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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18. Issue - *LEARNING STYLES*

How significant/important do you think it is to describe *preferred approaches to declared learning styles* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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19. Issue - *COLLABORATIVE LEARNING*

How significant/important do you think it is to describe *preferred approaches to collaborative learning* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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20. Issue - *INQUIRY LEARNING*

How significant/important do you think it is to describe *preferred approaches to inquiry learning* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

21. Issue - *VIRTUAL LEARNING*

How significant/important do you think it is to describe *preferred approaches to virtual learning* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

10

3.

Thank you - you are 1/3 of the way through the questionnaire. Your effort is greatly appreciated.

Just in case you need a refresher - the identified phases of an innovative learning environment development and implementation project are described as the following:
Phase 1 - DESIGN - the period of planning the physical and educational features of the new learning environment facility.
Phase 2 - TRANSITION - the period of first occupation and use of the new learning environment facility.
Phase 3 - CONSOLIDATION - the period of implementing the ongoing education practices of the new learning environment facility.
Phase 4 - RE-APPRAISAL - the period of exploring future options for the educational use of the learning environment facility.

22. Issue - *OCCUPANCY EVALUATION*
How significant/important do you think it is to undertake *occupancy evaluation* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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23. Issue - BUILDING PERFORMANCE EVALUATION

How significant/important do you think it is to undertake *building performance evaluation* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

24. Issue - COST EFFICIENCY EVALUATION

How significant/important do you think it is to undertake *cost efficiency evaluation* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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25. Issue - *TECHNICAL PROVISION EVALUATION*

How significant/important do you think it is to undertake *technical provision evaluation* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

26. Issue - *FURNITURE FUNCTION EVALUATION*

How significant/important do you think it is to undertake *furniture function evaluation* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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27. Issue - *USER COMFORT EVALUATION*

How significant/important do you think it is to undertake *user comfort evaluation* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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28. Issue - *SCHOOL OPERATIONS*

How significant/important do you think it is to consider the impact of *school operations* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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29. Issue - *USER ADAPTABILITY*

How significant/important do you think it is to consider the impact of *user adaptability* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

30. Issue - *STAKEHOLDER BUY-IN*

How significant/important do you think it is to consider the effectiveness of *stakeholder buy-in* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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31. Issue - *PROFESSIONAL ENGAGEMENT*

How significant/important do you think it is to consider the effectiveness of *teacher professional engagement* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

32. Issue - *TEACHER CAPACITY*

How significant/important do you think it is to consider the effectiveness of *teacher capacity* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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33. Issue - *SPATIAL AWARENESS*

How significant/important do you think it is to consider the effectiveness of *teacher spatial awareness* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

34. Issue - *TEACHING PROGRAMS*

How significant/important do you think it is to consider *the effectiveness of teaching programs* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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35. Issue - *STUDENT ENGAGEMENT*

How significant/important do you think it is to consider the *effectiveness of student engagement* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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36. Issue - *STUDENT WELL-BEING*

How significant/important do you think it is to consider the effectiveness of *student well-being* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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37. Issue - *SOCIAL MILIEU*

How significant/important do you think it is to consider the effectiveness of *student social milieu* at the described phases of a learning environment development   project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

38. Issue - *LEARNING ACTIVITIES*

How significant/important do you think it is to consider the effectiveness of *student learning activities* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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4.

Thank you - you are 2/3 of the way through the questionnaire. Your effort is greatly appreciated.

Just in case you need a refresher - the identified phases of an innovative learning environment development and implementation project are described as the   following:

Phase 1 - DESIGN - the period of planning the physical and educational features of the new learning environment facility.

Phase 2 - TRANSITION - the period of first occupation and use of the new learning environment facility.

Phase 3 - CONSOLIDATION - the period of implementing the ongoing education practices of the new learning environment facility.

Phase 4 - RE-APPRAISAL - the period of exploring future options for the educational use of the learning environment facility.

39. Issue - *FACILITY SUSTAINABILITY*

How significant/important do you think it is to consider the effectiveness of *facility sustainability* at the described phases of a learning environment development   project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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40. Issue - *REALISATION OF AFFORDANCE*

How significant/important do you think it is to consider the *realisation of affordance* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

41. Issue - *OPERATIONAL REFINEMENT*

How significant/important do you think it is to consider *operational refinement* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

21

42. Issue - *OCCUPANCY ADAPTATION*

How significant/important do you think it is to address *occupancy adaptation* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

[   ]

43. Issue - *QUALITY INDICATORS*

How significant/important do you think it is to consider *quality indicators* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

[   ]

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44. Issue - *STAKEHOLDER CONSULTATION*

How significant/important do you think it is to consider *stakeholder consultation* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

45. Issue - *PEDAGOGICAL FLEXIBILITY*

How significant/important do you think it is to consider *pedagogical flexibility* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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46. Issue - *SPATIAL OPTIMISATION*

How significant/important do you think it is to consider *spatial optimisation* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

47. Issue - *PROFESSIONAL PRACTICE*

How significant/important do you think it is to consider *teacher professional practice* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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48. Issue - *OPERATIONAL ALIGNMENT*

How significant/important do you think it is to consider *school operational alignment* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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49. Issue - *STUDENT ACHIEVEMENT*

How significant/important do you think it is to consider *student achievement* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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50. Issue - *STUDENT OWNERSHIP*

How significant/important do you think it is to consider *student ownership* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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51. Issue - *STUDENT VOICE*

How significant/important do you think it is to consider *student voice* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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52. Issue - *LEARNING CONNECTIONS*

How significant/important do you think it is to consider *learning connections* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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5.

Thank you - you have almost finished the questionnaire. Your effort is greatly appreciated.

Just in case you need a refresher - the identified phases of an innovative learning environment development and implementation project are described as the following:

Phase 1 - DESIGN - the period of planning the physical and educational features of the new learning environment facility.

Phase 2 - TRANSITION - the period of first occupation and use of the new learning environment facility.

Phase 3 - CONSOLIDATION - the period of implementing the ongoing education practices of the new learning environment facility.

Phase 4 - RE-APPRAISAL - the period of exploring future options for the educational use of the learning environment facility.

53. Issue - *FACILITY ADAPTATION*

How significant/important do you think it is to consider *facility adaptation* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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54. Issue - *FACILITY VIABILITY*

How significant/important do you think it is to consider *facility viability* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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55. Issue - *FACILITY RECONFIGURATION*

How significant/important do you think it is to consider *facility reconfiguration* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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56. Issue - PROFESSIONAL RE-IMAGINING

How significant/important do you think it is to consider opportunities for *professional re-imagining* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

57. Issue - DEVELOPMENTAL LEADERSHIP

How significant/important do you think it is to consider the role of *developmental leadership* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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58. Issue - *PEDAGOGICAL INNOVATION*

How significant/important do you think it is to consider the scope for *pedagogical innovation* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

59. Issue - *SPATIAL INNOVATION*

How significant/important do you think it is to consider the scope for *spatial innovation* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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60. Issue – *FUTURE LEARNING*

How significant/important do you think it is to consider the nature of *future learning* at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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61. Issue - *LEARNING CULTURE*

How significant/important do you think it is to consider the *learning culture* of the school at the described phases of a learning environment development project?

	Extremely significant/important	Moderately significant/important	Slightly significant/important	Not significant/important at all	I do not want to give a rating for this issue
Phase 1 - DESIGN	☐	☐	☐	☐	☐
Phase 2 - TRANSITION	☐	☐	☐	☐	☐
Phase 3 - CONSOLIDATION	☐	☐	☐	☐	☐
Phase 4 - RE-APPRAISAL	☐	☐	☐	☐	☐

Comment: what is the key reason for your decision?

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Appendix 4: Revised Questionnaire

FLEEquest

Factors for Learning Environment Evaluation

This questionnaire asks you to give responses to 23 questions on the significance of evaluation of issues relating to the development and implementation of innovative learning environments.

The language of the questionnaire assumes a certain level of expertise by respondents, but if you do not think that a question is clear or pertinent to your expertise you do not need to respond.

Responses will be analysed to identify the most significant factors, and to help identify the most appropriate approached to evaluation relevant to these factors.

The questionnaire related to factors identified in the "Framework of Factors for Learning Environment Evaluation. A copy of this framework is provided at the following

link: https://www.dropbox.com/s/licpkrr6hdoddtr/Framework%20for%20Learning%20Environment%20Evaluation.pdf?dl=0

1. How significant do you think the evaluation of EDUCATION PRINCIPLES is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

2. How significant do you think the evaluation of STAKEHOLDER ENGAGEMENT is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

3. How significant do you think the evaluation of COMMUNITY CONTEXT is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

4. How significant do you think the evaluation of SCHOOL IDENTITY is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

5. How significant do you think the evaluation of TEACHING APPROACHES is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

6. How significant do you think the evaluation of PROFESSIONAL LEARNING is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

7. How significant do you think the evaluation of INTEGRATED TECHNOLOGY is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

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8. How significant do you think the evaluation of LEARNING APPROACHES is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

9. How significant do you think the evaluation of COLLABORATIVE LEARNING is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

10. How significant do you think the evaluation of INQUIRY LEARNING is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

11. How significant do you think the evaluation of VIRTUAL LEARNING is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

12. How significant do you think the evaluation of STAKEHOLDER BUY-IN is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

13. How significant do you think the evaluation of PROFESSIONAL ENGAGEMENT is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

14. How significant do you think the evaluation of PEDAGOGICAL FLEXIBILITY is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

15. How significant do you think the evaluation of SPATIAL INNOVATION is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

16. How significant do you think the evaluation of STUDENT ENGAGEMENT is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

17. How significant do you think the evaluation of STUDENT WELL-BEING is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

18. How significant do you think the evaluation of SOCIAL MILIEU is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

19. How significant do you think the evaluation of LEARNING ACTIVITIES is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

20. How significant do you think the evaluation of STUDENT ACHIEVEMENT is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

21. How significant do you think the evaluation of STUDENT OWNERSHIP is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

22. How significant do you think the evaluation of STUDENT VOICE is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

23. How significant do you think the evaluation of LEARNING CULTURE is at the designated phases of an innovative learning environment project?

	Extremely significant	Moderately significant	Slightly significant	Not significant at all	N/A
Conceptualisation & Design	○	○	○	○	○
Implementation & Operation	○	○	○	○	○

Appendix 5: Summary of frameworks used in research

Groupings of models:

1. Technical performance orientation (POE – BPE)
2. Education systems/policy orientation (advocacy for positions)
3. Education ecosystems (situational orientation)

Group 1 Technical performance orientation						
Author(s)	Key Terms	Key Features	Relationships / Dynamics	Origin	Key Purpose	Comment
Copa & Pease (1992) *New Designs for the Comprehensive High School*	Learning Signature Learner Outcomes Learning Process Learning Organization Learning Partnerships Learning Staff (Learning Technology) Learning Environment Learning Cost	The model describes a comprehensive consultative process "Design Down" and provides design specifications to help interpret each point.	The process is presented as being tightly sequential to support an extensive consultation process to develop a widely supported design proposal.	Developed through the National Centre for Research in Vocational Education with an orientation to making high schools more suited to "preparing students for a changing world".	A model for stakeholder consultation in a learning environment development project.	The model presents and archetype for a new facility of 100 student family, 400 student neighbourhood, 1600 student community. The model and process were used in Iceland in a new school development project and was the basis of an evaluation project (Sigurdardottir & Hjartarson, 2011)
Author(s)	Key Terms	Key Features	Relationships / Dynamics	Origin	Key Purpose	Comment
Higgins et al (Design Council, 2013) *The Impact of School Environments: A literature review*	Systems and Processes Products and Services Communication Environment (Learning at the centre)	The school built environment: Temperature Air quality Noise Light Colour Other The physical environment of the classroom: Furniture Equipment Arrangement and layout Display and storage ICT Catering Community involvement	The model does not propose a particular dynamic between the concepts and/or elements, but uses the following criteria to evaluate the effectiveness of each concept through the data analysis: Attainment Engagement Affect Attendance Well-being	The model is claimed to be original for this research project but acknowledges that it draws on contemporary literature from the UK and US in the field.	The model is a conceptual organiser for the literature. review and the subsequent report.	The model does not suggest any relationship or dynamic between the concepts of the framework or the elements referred to subsequently. While the commentary refers to "complex environments and interactions" there is no theoretical framework for analysing and interpreting relationships and interactions.

Author(s)	Key Terms	Key Features	Relationships / Dynamics	Origin	Key Purpose	Comment
Preiser & Nasar (2008) *Assessing building performance: Its evolution from post-occupancy evaluation*	Effectiveness Review Program Review Design Review Commissioning Post Occupancy Evaluation Market Needs Analysis	Building Performance Criteria are at the core of evaluation. Includes the perspectives of users as consumers in the evaluation. The process is iterative to inform future projects.	Evaluation should work through cycles of planning, programming, design, construction, occupancy, adaptive re-use, recycling.	From an architectural background it seeks a more holistic approach to evaluation than previous POE approaches.	Key purpose is feeding forward into the next building cycle	The intention is to make POE a more diagnostic and developmental process.
Author(s)	Key Terms	Key Features	Relationships / Dynamics	Origin	Key Purpose	Comment
OECD/CELE (OECD, 2009) *Evaluation of Quality in Education Spaces*	Priority-rating exercise Educational facility analysis Student and staff questionnaires Focus groups (for staff and students)	Quality indicators are developed from OECD quality performance objectives local contextual factors.	The Framework is intended to be a multi-dimensional, policy-oriented tool that can be used across jurisdictions, rather than a checklist.	Developed through the ongoing work of the PEB/CELE project of OECD. This is a deliberate attempt to make evaluations of education facilities more education-oriented.	Aims to assist education authorities and schools to optimise use of and investment in educational spaces.	A meta-framework that includes a suite of tools.
Group 2 Education systems/policy orientation						
Author(s)	Key Terms	Key Features	Relationships / Dynamics	Origin	Key Purpose	Comment
Owens & Valesky *(2015) Organizational Behaviour in Education: Adaptive Leadership and School Reform*	Ecology Organization Culture Milieu	Building and facilities Technology Pedagogical Inventions Communication Patterns Decision-making patterns Hierarchy Formal Structure Bureaucratization Assumptions Values Norms/beliefs Behaviour patterns Artefacts Race, ethnicity, gender Motivation Leadership Socioeconomic levels	The four dimensions are said to be "dynamically interactive", but the nature of this interaction is not elaborated. The dimensions sit within an external environment: social, political, economic, technological, legal, demographic, ecological and cultural systems.	The model sits in a theoretical context of organizational management. The authors acknowledge the work of Renato Tagiuri in organizational culture and business systems.	The purpose of the framework is to offer a model of organizational culture and organizational climate that can be used by school leaders to manage school reform projects.	Although the concept of "ecology" (building and facilities, technology, pedagogical inventions) is a part of the model the concept is not elaborated at all in the text and is not addressed as a part of the dynamic of the model.

		Status				
Author(s)	Key Terms	Key Features	Relationships / Dynamics	Origin	Key Purpose	Comment
Johnson & Lomas (2005) *Design of the Learning Space: Learning and Design Principles*	Conceive Design Implement Operate (CDIO)	Institutional context Learning principles Learning activities Design principles Construction requirements Evaluation & improvement	Proposes a cycle: Identify the institutional context Specify learning principles Define learning activities Develop clearly articulated design principles Create a set of requirements Determine a methodology for assessing success.	Published through EDUCAUSE.	Has an orientation to promoting technology rich learning.	Although there is a key feature of "evaluation and improvement" in a chapter section *Determining a Methodology for Assessing Success* this is not actually addressed. Reference is made to relative life-cycles: life-cycle of a building, life-cycle of technology, life-cycle of learning theories.
Author(s)	Key Terms	Key Features	Relationships / Dynamics	Origin	Key Purpose	Comment
Radcliffe (Radcliffe et al., 2008) *Learning Spaces in Higher Education: Positive Outcomes by Design*	Pedagogy Space Technology	The model does not identify specific elements, but provides guiding questions that could help expand each component e.g. "What types of learning and teaching are we trying to foster?" "What aspects of the design of the space and provisioning of furniture and fittings will foster these modes of learning and teaching? " "What technology will be deployed to complement the space design in fostering the desired learning and teaching patterns?"	The model emphasises the two-way interactions between each of the core concepts: Enables/encourages Extends/embeds Enhances/enlarges.	Developed through the Next Generation Learning Spaces Project funded by the ALTC.	Key factors to inform the conceptual design and post-occupancy evaluation of either discrete learning environments or networks of places.	The PST framework introduces a life-cycle concept with two stages: conception and design, and implementation and operation.
Author(s)	Key Terms	Key Features	Relationships / Dynamics	Origin	Key Purpose	Comment
Lippman (2010)	Learner	No elements given	The author emphasises the	The model is developed by the	The purpose of the model	While the model has

Author(s)	Key Terms	Key Features	Relationships / Dynamics	Origin	Key Purpose	Comment
Evidence-Based Design of Elementary and Secondary Schools	Physical Environment Social Environment		significance of a transactional interrelationship between each of the concepts.	author in his own work.	is to emphasise the significance of a transactional interrelationship between each of the concepts.	some elegance, in itself, it is not referred to in the text. The text refers to Communities of Practice and Schools as Learning Communities.
Author(s)	**Key Terms**	**Key Features**	**Relationships / Dynamics**	**Origin**	**Key Purpose**	**Comment**
Reushle (2012) *Designing and Evaluating Learning Spaces: PaSSPorT and Design-based Research*	People Space Pedagogy Technology	Adds People to the PST model and emphasises the role of stakeholders (students, teachers, technicians, others) in the evaluation of learning spaces.	Suggests phases of conception & design / implementation & operation in projects of designing learning spaces.	Written as a review of the implementation of the Australian Digital Futures Institute at USQ.	The model proposes a process for evaluating the design and implementation of learning, teaching and research spaces.	Interesting in that it adds people to the TELL situation.
Author(s)	**Key Terms**	**Key Features**	**Relationships / Dynamics**	**Origin**	**Key Purpose**	**Comment**
NMC Horizon Report *(L. Johnson, Adams Becker, Estrada, & Freeman, 2015b)* *Horizon Report: 2014 K-12 Edition*	Content & Curricula Assessment Learning Practices Teaching Practices Organization Leadership & Values Connectedness Infrastructure	There are 28 elements across these nine organizing concepts. The elements for infrastructure are: ICT Infrastructure Physical space.	The framework sees learning environments as live ecosystems that evolve over time, changing in tune with the context and culture in which they reside.	The framework is taken from the "Up-scaling Creative Classrooms in Europe" (CCR) project.	The framework is seen as providing a systematic approach to scaling up innovative pedagogical practices, especially in ICT-enabled learning settings.	The model highlights the problem that arises when so many elements are included - the difficulty of identifying and evaluating relationships.
Author(s)	**Key Terms**	**Key Features**	**Relationships / Dynamics**	**Origin**	**Key Purpose**	**Comment**
Partnership for 21st Century Learning (2012) *Building Your Roadmap to 21st Century Learning Environments*	Assessment & Accountability Leadership & Culture Learning Teaching & Professional Learning Infrastructure	Adaptable Personalized Multiple measures Promote Growth Contextual Distributed Open Culture Advocating Visionary Rigorous Personalized Collaborative Inquiry Based Adaptable Equitable Collaborative Student Focused Facilitated Flexible Security	3 stage model Planning Building Transforming	Developed by a "body of experts" for the p21 consortium. Available free on-line. www.roadmap21.org	Promoting "21st century learning" with an orientation to technology rich learning.	The model emphasises the uniqueness of individual situations and provides a tool to help planning at school and district level. (Situational analysis)

Author(s)	Key Terms	Key Features	Relationships / Dynamics	Origin	Key Purpose	Comment
		Capacity Hardware Support Budget				
Ellis & Goodyear (2016) *Models of learning space: integrating research on space, place and learning in higher education*	People Tasks Tools, artefacts Activity Outcomes	e.g. Friends Workmates Teams Communities Macro Meso Micro e.g. Books Wikis Email e.g. Problem solving Reflective Mental Physical e.g. Cognitive Psychomotor Affective Engagement Enculturation	An iterative cycle of production, maintenance, extrinsic & intrinsic feedback.	Developed as part of research for ARC and ALTC projects.	A model to facilitate research in learning spaces in universities.	This model is from earlier work of the authors (2008). It does not seem to add to the ideas developed in the previous paper.
Group 3 Education ecosystems / situational analysis						
Author(s)	**Key Terms**	**Key Features**	**Relationships / Dynamics**	**Origin**	**Key Purpose**	**Comment**
Gislason *(2009) Architectural design and the learning environment: A framework for school design research*	Ecology Organisation Student milieu Staff culture	Building design Technology and other material elements Teaching, scheduling and curriculum Learning and motivation, social climate Assumptions, values, and patterns of thought and behaviour	The diagram of the model shows the same overlapping interactions as the original, but while Gislason points out that Owens and Valesky do not address the relationship between ecology and the other three dimensions (p128), he does not make any theorized specific mention of the possible relationships himself.	Gislason acknowledges that the model is adapted from Owens and Valesky (2007).	Gislason uses the model to frame his field research in the form of case studies of three open-plan high schools in Minnesota.	Gislason concludes that the model is useful in highlighting the linkage between design, organization, culture and milieu, but that there is a need for design to be viewed as a more integral part of the network of elements.
Author(s)	**Key Terms**	**Key Features**	**Relationships / Dynamics**	**Origin**	**Key Purpose**	**Comment**
OECD / CERI *(Development, 2013) Innovative Learning Environments*	Resources Learners Content Educators	The text does not list definitive features of the elements of the framework. The framework is presented on several	The learning environment is described as a holistic ecosystem that functions over time and in context. Pedagogy and organisation are	The report claims it is a significant innovation to add resources to the traditional triad of learners / content / educators in educational analysis.	The model is an organiser to show where evidence from case studies can be located rather than a	The model is pragmatic rather than theoretical in that is derived from the interpretation of 125 case studies.

Author(s)	Key Terms	Key Features	Relationships / Dynamics	Origin	Key Purpose	Comment
		occasions to highlight the location and relationship of a range of elements that are addressed.	dynamics that link the elements.		theoretical framework to support critical analysis.	
Blackmore et el (2011) *The connections between learning spaces and learning outcomes: people and learning places?*	Practitioners Learners Spaces Design Transition Consolidation Sustainability / Re-evaluation	The framework uses a matrix of Practitioners / Learners / Spaces with the time phases of Design / Transition / Consolidation / Sustainability / Re-evaluation to identify 50 separate elements.	The text makes several references to the complexity of the relationships between the organising concepts and the separate elements, but the framework does not help identify a purpose or pattern to relationships.	The framework was developed by the project as an organising tool for the literature review.	Organising framework for literature review.	The framework and report highlight the challenge of maintaining elegant simplicity in conceptualising the key elements, time phases and relationships in learning environment evaluation.
Lee & Tan (2008) *A comprehensive learning space evaluation model*	Design Build Occupation (In a continuous cycle)	Key needs and experiences. Curriculum driven concepts. Involving stakeholders. Best practice in similar circumstances. Monitoring changes. Living with value management. Involving stakeholders in progress. Planning next stages. The current experience The physical context The curriculum context Future needs	Seen as a baseline model of the development of learning spaces through three interconnected stages. Presupposes a process of evaluation that is similar to that of the action-research cycle.	Developed for an ALTC project.	The model was used in a series of trial evaluations. The outcomes of three of these are reported on the project website.	The three evaluations presented are quite disparate and demonstrate how difficult it can be to keep an evaluation aligned with initial planning goals and processes.
Top Mark Schools project for RIBA (Plotka, 2016) *Better spaces for Learning Outcomes-based model for*	Good design in Schools Education Activities Pupil Outputs	Design that supports educational activities and optimises operational efficiency.	Promotes the value of collaborative design using a planning tool.	Developed by the Royal Institute of British Architects.	The framework seeks to capture and quantify good design in line with government	Emphasises the value of a design tool that enables flexibility for application in individual circumstances.

Author(s)	Key Terms	Key Features	Relationships / Dynamics	Origin	Key Purpose	Comment
quantifying benefits of good school design	Education Outcomes	Attitudes Perceptions Behaviours Activities Learning Behaviour Engagement Wellbeing			methodologic al approaches to measuring the social impacts of policy measures	
Author(s)	**Key Terms**	**Key Features**	**Relationships / Dynamics**	**Origin**	**Key Purpose**	**Comment**
Ministry of Education, New Zealand (2017) *Innovative Learning Environments (ILE) guide*	Understanding pedagogy Using a collaborative process Providing professional learning Designing flexible spaces Involving students in planning Involving parents and whanau in planning	ILE as an ecosystem UDL as principles of learning Student-centred design Plan for flexibility School vision to support ILE Representative planning team Plan and evaluate with stakeholders Prepare teachers for change Develop collaborative teaching Build teacher capacity Design adaptable spaces Make spaces socially and culturally inclusive Plan for wellbeing Prepare for change Scaffold students in transition Involve students in decision making Identify community needs Partner with parents Engage with community	The guide is presented as an online tool that can be navigated in a range of ways. The model does not present any statement of relationship or dynamic between or across the parts.	Developed by the NZ MOE.	A support for school leaders, teachers and parents in developing ILEs.	The model is comprehensive but could become overwhelming. Each organising concept (6) is broken down into key ideas (26 in all) which each have a series of key resource documents (121 in all).
Author(s)	**Key Terms**	**Key Features**	**Relationships / Dynamics**	**Origin**	**Key Purpose**	**Comment**

Basye, Hausman & Johnston for ISTE (Basye et al., 2015) *Get Active – Reimagining Learning Spaces for Student Success*	Visionary Leadership	Inspire and facilitate Strategic development Ongoing processes of development Manage resources	The dynamic is administrative leadership. The relationship is engaging with technology rich active learning.	International Society for Technology in Education. Available online www.k12blueprint.com/get-active Sponsored by Intel and Steelcase	One of a suite of resources prepared by ISTE to promote engaging with technology rich active learning.	The focus is on leadership for change in K-12 school situations. The change is the implementation of technology rich learning to support the ISTE model of "active learning".
	Digital age learning culture	Ensure continuous engagement with digital age learning Model & promote effective technology				
	Excellence in professional practice	Ensure effective practice with technology Ensure adequate time and resources Promote learning communities				
	Systematic improvements	Engage stakeholders Stay abreast of trends Lead powerful change Collaborate with staff				
	Digital citizenship	Establish partnerships Ensure robust infrastructure Promote understanding of social and ethical issues Promote responsible social interactions				

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Author/s:
Oliver, Graeme John

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