SCIENCE OF LEARNING
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Higher Education Learning Framework

An evidence-informed model for university learning

This study was supported by the Science of Learning Research Centre (SLRC), The University of Queensland and The University of Melbourne.

Established in 2013, the SLRC is a Special Research Initiative of the Australian Research Council, bringing together researchers from across Australia in the disciplines of education, cognitive psychology, and neuroscience. Consisting of 25 Chief Investigators from nine universities across Australia, the Centre is administered by The University of Queensland. The main goal of the SLRC is to improve learning outcomes – in the early years, during formal schooling, and at a tertiary and vocational level.

Please cite this handbook as:

Nugent A., Lodge, J. M., Carroll, A., Bagraith, R., MacMahon, S., Matthews, K. E. & Sah, P. (2019). *Higher Education Learning Framework: An evidence informed model for university learning*. Brisbane: The University of Queensland.

ISBN: 798-1-74272-229-0

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INTRODUCTION

Learning as a developmental process is the central consideration of effective higher education. Grounded on a synthesis of existing frameworks, literature, and research on the topic, the Higher Education Learning Framework (HELF) was informed by interviews with national and international experts in learning and higher education offering the latest thinking on university learning. A science of learning lens was applied during development, threading together the often-disparate thinking in education, neuroscience, and psychology, to offer a convergent framework on effective learning in higher education. This unprecedented approach to understanding learning in a tertiary context provides a robust framework that can broadly guide the higher education sector.

Although the HELF is couched in terms of implications for teachers, students and assessment, it is a model that can be adopted in its entirety at an organisational or faculty level, or used on an ad hoc basis to inform the decisions that impact student learning. At an individual level, the HELF provides a framework that teachers can use to reflect on their current practice, finding affirmation for the excellent teaching that is already occurring in the higher education sector, and identifying priority areas for growth and change. The principles are not intended to be prescriptive but merely suggestive, depending on the relevant learning and teaching conditions. There is no suggestion that a high-quality learning experience requires all the principles to be addressed. The order of presentation of the principles is not intended to be sequential or hierarchical. As is to be expected, all the principles have some degree of inter-relatedness due to the inherent nature of learning itself.

We present a framework for higher education learning that you, as an individual or as an organisation, can build upon, adapt and tailor to your particular context. Acknowledging that there may be concepts that are new to you, principles that might not align with your experience and themes you consider important that are absent, we do not perceive this as a fault. The HELF is the product of a rigorous study of learning in the higher education setting and provides a solid foundation which can be adopted and adapted to create a personalised framework for your context.

Overview of the HELF

The HELF is based on the seven main themes emerging from a rigorous study into higher education learning undertaken by the authors. From these themes, principles relating to university learning were drawn. In the following pages each of the seven themes will be interrogated, providing (1) an explanation of the principle, (2) implications of the principle for teachers, students and assessment and (3) a discussion of the current literature relating to the principle.

A separate chapter will be devoted to each of the seven themes:

1. Learning as becoming
2. Contextual learning
3. Emotions and learning
4. Interactive learning
5. Learning to learn and higher order thinking
6. Learning challenge and difficulty
7. Deep and meaningful learning.

How to use this book

A brief description of each of the principles is described on page 3. We recommend this as a starting point, particularly for readers who do not routinely delve into the field of education research, and are unfamiliar with the terminology. As you read through the principles, some may resonate with you more than others, some may spark your curiosity; you may find yourself quietly smiling as you reflect on how well you already incorporate a particular principle into your practice, or ponder at the realisation that there are gaps in your practice that you can now put a name to. Hopefully all of this will make you want to read on – most likely jumping to your favourite principle.

A separate chapter is dedicated to each of the seven principles that constitute the HELF. We stress that the order of chapters does not represent a hierarchy of importance, and no one principle is superior to another. Equally, although the principles are represented as stand-alone constructs, with minimal overlap, it must be appreciated that the principles are intrinsically and irreversibly intertwined. For that reason, although it is not necessary to read the chapters in a sequential order, care should be taken in considering any one principle in isolation.

Each chapter provides an explanation of the principle. This is drawn from the higher education literature and evidence from the science of learning, overlaid with insights from interviews with experts as part of the HELF study, and describes the main constructs that relate to the principle.

Following the explanation there are examples of strategies for operationalising the constructs. These are not exhaustive, but rather provide guidance as to indicative strategies that can be explored. The strategies are divided into 3 headings: (i) strategies for university teachers, (ii) strategies for students and (iii) strategies for assessment. Although students per se are not a target audience of this book, we encourage educators to share these strategies for effective learning with students.

For those keen to extend their understanding around each of the constructs within a given principle, at the conclusion of each chapter a brief theoretical overview highlighting key literature is provided. This is by no means an exhaustive account of the literature, but it will provide an entry point for engaging further with the theory and evidence supporting the principle.

Depending on your role in university education you may wish to apply the HELF principles for varied purposes:

- Individual level
  - > Reflecting on teaching practices – finding affirmation for the excellent teaching that is already occurring in the higher education sector and identifying priority areas for growth and change
- Faculty/course
  - > As a development tool in course design, and as a diagnostic tool for identifying gaps in student learning across courses and programs
- Organisational level
  - > Exploring teaching capability and tailoring professional development accordingly, teaching recognition and reward, development of teaching and learning policy/practices.

Key points to using the HELF Framework

- The principles are inter-related
- The principles are not hierarchical
- A high-quality learning experience does not require each of the HELF principles to be enacted every lesson
- Strategies are suggestive, not prescriptive
- Strategies provided are not exhaustive
- The literature reviews are a starting point to further research.

Summary of the HELF principles

Learning as becoming

A university education provides a learning experience that broadens students' knowing and being for life beyond the classroom

This principle relates to the holistic experience of university education. It embodies the transformational journey of students to become citizens of the world, able to ethically consume, evaluate, create, transform and apply knowledge in their everyday life, as well as their occupation, now and into the future.

Contextual learning

Learning occurs in context, and context can be used to enhance the learning experience

Contextual learning aims to reflect or emulate authentic practice or problems. Exploring content in context makes the learning experience more relevant, meaningful and engaging, and develops students' capacity to apply learning to novel and unfamiliar contexts.

Emotions and learning

Emotions play a role in how and why students learn

Emotions are essential for and fundamental to promoting or inhibiting learning. Key cognitive skills such as problem-solving, decision making, and creative and critical thinking are often impacted by emotions, which can influence learner attitudes, behaviours and achievement.

Interactive learning

The social dynamics of learning can be leveraged to enhance the learning experience

The social dynamics of learning relates to the conscious and unconscious processes underpinning how students and teachers interact in learning environments, both physical and virtual. Social interaction directly influences learner engagement and achievement, and can be leveraged to enhance learner efficiency, co-creation of knowledge, innovation, and effective collaboration to find solutions to complex learning problems.

Learning to learn and higher order thinking

When students employ effective methods of thinking, and understand how they learn, they can improve the way they learn

Students that are aware of thinking processes and learning strategies, when to use them, and how to evaluate their effectiveness and appropriateness can optimise their thinking and learning. These strategies and processes can be explicitly taught to develop self-regulated learners who are able to make judgements on their own learning and take decisive steps for improvement, maximising the efficiency and effectiveness of their learning.

Learning challenge and difficulty

Challenge and difficulty can be beneficial for students' learning process

Learning experiences that involve struggle and effort, and even confusion, can positively alter how students think about their learning, and promote persistence and resilience. These attributes are important for greater depth of understanding, complex problem solving, and transfer of knowledge to novel contexts.

Deep and meaningful learning

Learning is built on prior knowledge and engages students in deep and meaningful thinking and feeling

This aspirational principle encapsulates an ideal outcome for a student's learning experience in that they engage beyond passivity towards deep and meaningful thinking and feeling. This involves the explicit connection of new content with individual students' prior knowledge and experience. Many of the key concepts and lessons from the other principles are integrated into deep and meaningful learning.

"A university education provides a learning experience that broadens students' knowing and being for life beyond the classroom"

CHAPTER 1

LEARNING AS BECOMING

Explanation

A university education provides an experience for learning that broadens students' thinking for life beyond the classroom. A degree should not be limited to focusing only on the acquisition of a pre-specified set of knowledge and skills. Students commit a significant amount of time and effort to invest in an immersive and challenging learning experience that leads them to conceptually and professionally alter or transform themselves. An ontological emphasis on who students are becoming as professionals, scientists, or scholars as well as what they ought to know and be able to perform, can serve to enrich the quality of a student's learning experience and their investment. When students understand what they are becoming and can begin to answer questions like 'What's entailed in the discipline?'; 'What does it mean to be a practitioner in that discipline?'; 'Why does it matter?'; and 'How can one make a contribution to community and society?', what they learn can take on greater meaning and purpose. It is also easier for students to contextualise their learning and fosters deep and meaningful thinking.

Over the course of university life, students will experience a shift in their self-identity as they develop the ability to answer ontological questions of becoming; understand what their education means to their life; know the nature of knowledge in the discipline; understand what it means to be a practitioner in that discipline; and understand what contribution they can make as educated citizens. Their identity transforms and expands to include their ontological becoming. For some degrees, this can be a more, or less, profound experience. Nevertheless, across all programs, university teaching should aim to foster the opportunity and ability for students to explore these ontological questions related to their study. In doing so, university teachers will cultivate a learning experience for students that is more likely to be transformational.

The theme *learning as becoming* extends beyond the professional context and encompasses an educational experience where students are aligned with the community and society. Above and beyond exposure to those contexts, when students become aligned with community and society, they develop an understanding of how their community relates to society and how their discipline relates to both community and society. Furthermore, students understand how their knowledge and skills fit within the environment of their discipline, the community, and society – in a sense thinking big picture. This represents an ecological perspective of university education where it is not only how the broader context influences a student, but also how a student influences the broader context. This community and society alignment also engenders ethical development and civic responsibility in students. This occurs because students become aware of the issues that face the community and society, and seek to respond to them as they make their contribution, even as students. For example, in a primary school teaching degree, a pre- service teacher comes to understand children in the classroom context, and also how that child's family, the school community, the school administration, government policy and other broader factors, ultimately affect what and how a pre-service teacher learns and practices. A student of biotechnology appreciates the potential for genetic engineering to address the world food crisis and the ethical considerations and societal concerns around genetically modified organisms, and how research in the discipline responds to and is shaped by societal influences.

Through a university education, students have opportunities to experience a philosophical shift or conceptual transformation in understanding, or consolidation, of key topics or theories related to their discipline, and where appropriate, transition through threshold concepts. This means not only gaining a deep understanding of the content within the discipline, but also the purpose and the contribution of that knowledge to the

discipline as a whole, and moreover to broader society. Examples of some concepts that hold the potential for conceptual or philosophical transformation are gravity in physics and engineering or opportunity cost in economics: understanding these key concepts unlocks the student's ability to engage with and explore the respective disciplines.

A university education ought to also develop students into critical and creative thinkers, with an appreciation of the conditionality of knowledge. It should foster students' understanding that knowledge is never a fact, it is a conditional assumption underpinned by theory and convention, which evolves as that theory and convention is supported or falsified. As a result, students will come to appreciate that knowledge is dynamic and those in their discipline (e.g., peers, lecturers, professionals) take positions on that knowledge. This means that students should continually explore epistemology through critical and creative thinking to take their own positions. Training students as critical and creative beings prepares them well for lifetime employment in an evolving job market where thinking skills are valued more than studied knowledge during university. Students will become more capable of translating knowledge, innovating to create new knowledge, and crafting their knowledge and skills for a variety of jobs, and even jobs that do not yet exist. Critical and creative thinking is further explored in the theme *learning to learn and higher order thinking* in chapter 5.

The *learning as becoming* theme also encourages students to adopt a developmental perspective on learning so that students see themselves as self-directed lifelong learners. Similarly, this supports a pedagogical underpinning that endorses a university education, which is not seen as a sequential pathway to prepare students for a future life of working in their discipline, but rather that education is in fact a part of life. In this way, learning and working are not distinct. This means viewing students' status as members of society, their time at university, and their professional future as an integrated experience. In turn, this influences the way we teach and interact with students, as well as the way we frame their learning process as enduring, not finite.

Strategies for university teachers

University teachers can explore learning as becoming by considering the following strategies when developing their learning and instructional design:

- As experts in the discipline, university teachers are well positioned to identify and present to students key topics or theories that university teachers believe hold potential for conceptual or philosophical transformation. At the same time, university teachers should also recognise their expert blind-spot, and collaborate with students to hear what students have found to be conceptually or philosophically transformational in their course.
- When designing courses, it is worthwhile to take a program-based view of the degree and examine how ontological questions of learning as becoming are being addressed. For example, this could mean collaborating with colleagues in other degree-related courses in backward mapping the curriculum for appropriate content considerations, but at the same time also answering questions such as 'How does this course help students to understand the meaning of becoming a researcher or practitioner in this discipline and why does it matter?' and 'How does this course prepare students to make a contribution to community and society?'
- Encourage students to think about how they can situate and transfer their knowledge in community-related contexts. This also means, where possible, including learning activities related to the community. Furthermore, university teachers can encourage students to engage in self-reflective learning activities that explore how the broader contexts of community and society influence a student, and how they can influence community and society. In these instances, technologies such as electronic portfolios that incorporate self-reflection elements across a degree can be useful to help students self-reflect on these ontological aspects during a course, and after a course, as well as compare and extend on their self-reflections as they progress in further courses.
- Explore with students how undertaking a course or degree program can influence their self-identity, and encourage students to be open to exploring how it impacts upon their beliefs, perceptions, social interactions, and behaviours, inside and outside of the classroom.
- Explore with students both the conditional nature of knowledge in the discipline, and how it is the students' responsibility to examine and question that knowledge. That means also examining with students the role of a lecturer as a facilitator of knowledge, and not an absolute source of knowledge. In doing so, university teachers should explore their personal epistemology with students throughout a course and encourage students to explore and further develop their own.
- Encourage students to adopt a mindset of education as a lifelong pursuit by examining examples of lifelong learning. For example, examine with students how successful practitioners within the discipline have engaged in continuing professional development to respond to theoretical advances in a topic area.

Strategies for students

Students can explore learning as becoming by considering the following strategies during their learning experience:

- When exercising the choice to decide how to prioritise study, students should consider key topics or theories emphasised by the lecturer, or highlighted in the course learning objectives, as these topics may hold value for potential conceptual or philosophical transformation.
- Appreciate university teachers as facilitators of knowledge who embody knowledge in their own unique ways, avoid relying on university teachers as an absolute source of knowledge. In doing so, students can take the responsibility to critically examine the discipline knowledge offered by university teachers and develop their own personal epistemology around that discipline knowledge.
- Students should attend to the broader context during learning by regularly engaging in formal or informal self-reflection exercises. In these self-reflection exercises, students can explore how the broader contexts of community and society influence the learning material, and how they can influence community and society through their learning. Furthermore, self-reflection can prompt investigation of how undertaking a course or degree program influences self-identity; students should be open to exploring how that influences perceptions, social interactions, and behaviours, inside and outside of the classroom.

Strategies for assessment

Assessment is an important part of the learning experience for students, and university teachers can explore learning as becoming by considering the following strategies for assessment:

- Include a variety of self-reflective assessments, whether informal or formal, so that students have time designed into the course to examine and self-reflect upon the ontological aspects discussed in learning as becoming. An extension of this is to have students compare and contrast their self-reflections so that they can examine other students' perceptions and experiences.
- A distal outcome of assessment should be that students are able to attest and explain what their knowledge and skills mean to the world and their discipline. This is a step beyond simply explaining the specified bodies of disciplinary knowledge and skills they have acquired, but what their knowledge and skills mean for their ability to impact and influence society at large, and how they can address problems outside of their discipline with their disciplinary knowledge and skills. In this sense, consider the ways assessment can be contextualised so that it reflects more authentic and real-world contexts with adequate scope for students to explore their knowledge in the ways described above.

Principle theoretical/literature overview

The theme *learning as becoming*, as interpreted in the HELF, relates to the transformation of learners, how they think about themselves and their relationship with society, and how they think about knowledge. It may be viewed as the product of a university education, however by necessity it must be considered in the process of educating students. This principle is philosophical in nature, dealing with issues such as ontology (i.e., the nature of being or existing) and epistemology (i.e., how we know what we know). The principle promotes an approach to higher education where adequate ontological consideration is given.

A philosophical approach to education that addresses ontological considerations has had prominent early proponents (such as Heidegger, 1977), which in recent times have been elaborated upon (Barnett, 2004, 2009; Dall'Alba, 2005, 2009; Dall'Alba & Barnacle, 2007). It has been suggested that, in teaching and learning, ontological considerations should not be subsumed by, demoted, or detached from epistemological consideration (Barnett, 2004, 2009; Dall'Alba & Barnacle, 2007; Dall'Alba & Sandberg, 2010). What has become convention in higher education is that epistemological consideration takes primary focus, which has otherwise led to a knowledge acquisition focus that does not afford students all the potential of a more transformational educational experience. Dall'Alba (2009) argues that learning is broad and involves the integration of knowing, acting, and being, and how those units for learning are altered and constructed. In that sense, ontological and epistemological considerations for higher education are inextricably linked, much like how the experiences of knowing, acting, and being can co-occur and do not require segmentation for teaching and learning.

With an ontological consideration, knowing becomes situated or arises from personal, social, historical, and cultural experiences of being-in-the-world, insomuch as knowledge transforms into something inhabited and enacted (Barnett, 2004, 2009; Dall'Alba & Barnacle, 2007). In this way, formal propositional knowledge and informal knowledge are interrelated, and the two enhance one another in different ways through consolidation, not isolation. Furthermore, through an ontological perspective knowledge can also be considered as embodied (Lipson, 2012).

An ontological perspective for higher education has led to some discussion of its relevance to concepts of teaching and learning contextualisation (Barnett 2004, 2009; Dall'Alba & Barnacle, 2007). What is commonly proposed is that contextualisation aids an ontological imperative by structuring learning to be situated in any form of practice, but it should not be treated as a pedagogical solution to replace ontological consideration. Ontological consideration requires an understanding of complex interrelationships of social, emotional, and cultural factors within contextualised learning experiences, which marries the dynamism of informal knowledge with formal knowledge, and how that integrates into knowing, acting, and being (Barnett, 2004, 2009; Dall'Alba & Barnacle, 2007).

Addressing ontological considerations in higher education helps to prepare students for dealing with the ambiguities of becoming (Dall'Alba, 2009), and the challenges they face in an often uncertain and changing world. In doing so, they learn to become more capable of adaptability and reflectivity as creative and critical beings (Barnett, 2012). It is proposed that becoming through an ontological lens is a perpetual process (Dall Alba & Barnacle, 2007), which can be considered alongside traditional proponents for lifelong learning in contemporary education and professional practice (Edwards & Usher, 2001; Hake, 1999). In this way, learning is an integrated lifelong experience of being that addresses social, emotional, and other qualities (Barnett, 2012a; Su, 2011), such that students are on a lifelong learning pathway before, during, and after they are students in that discipline.

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"Learning occurs in context, and context can be used to enhance the learning experience"

CHAPTER 2

CONTEXTUAL LEARNING

Explanation

Learning does not occur in a vacuum, it occurs in a context. The learning process is inherently contextual. Context can constitute subject-matter domains and disciplines (e.g., learning in the culture and conventions of science or arts domains), situational/physical settings (e.g., learning in the context of university classrooms, home, and workplaces) and social interactions (e.g., learning in the context of a relationship between a student and experienced professional/lecturer/patient/consumer). These contexts can be explored in teaching and learning through a variety of related approaches and techniques.

Even when the context is, or is not meant to be attended to, extensive brain regions automatically engage to process context, suggesting that context is synchronously associated with desired learning content. As expected, context also plays a role when learnt content is recalled from memory. Appreciating that context is attended to when learning, university teachers and students can use context to enhance learner engagement, academic performance, and the ability to transfer knowledge between contexts and to novel contexts (including those indicative of the studied discipline and/or profession).

Some more commonly discussed teaching approaches include contextualised learning, real-world learning, project-based learning, problem-based learning, case-based learning, work-integrated learning, and simulated learning, to name a few. A common theme among these approaches is that learning is contextualised in a way that reflects or emulates professional practice and problems. This is advantageous since the learning process becomes embedded in varied and relevant professional contexts, helping to engage students as they become immersed in a more authentic experience. Students can then see the relationships between what they are learning in an academic or university context and the world outside. As students explore content across different contexts that are relevant, it encourages students to react dynamically across contexts to effectively perform around a certain learnt topic. Together, this culminates in a learning experience that becomes more appropriately situated and contextualised in practice and prepares students for the workforce and life.

Contextualised learning also engenders opportunities for students to learn what it actually means to be a practitioner in that domain, be it a scientist, lawyer, psychologist, historian, engineer etc. and to think and react like those practitioners (e.g., deconstruct and solve problems and apply the same strategies) instead of simply knowing what they know. In these situated or authentic learning experiences students can also develop softer skills such as interpersonal skills and ethical development, not otherwise as common in non-contextualised learning. This aspect of learning is explored in more depth within the principle *learning as becoming* in chapter 1.

Contextualisation is not so much a static outcome that is achieved or not achieved in teaching, but rather a dynamic element for consideration in learning design and assessment, and dependent on the circumstances of the course. That means there is a continuum for when and how much contextualisation can be achieved for students. Extensive contextualisation might not always be possible, but any teaching efforts in learning design and assessment that strive towards a level of contextualisation is highly beneficial for student learning.

Contextual learning can also provide opportunities for students to examine different perspectives not only from peers, but from those contained in other disciplines, and embedded in practice which may, or may not, align with those presented solely in an academic setting. This aspect of learning is explored in more depth within the theme *interactive learning* in chapter 4.

Strategies for university teachers

University teachers can leverage context to enhance a student's learning experience and outcomes by considering the following strategies when developing their learning and instructional design:

- Utilise contextualised teaching approaches and techniques (e.g., case-based learning, project-based learning, simulated learning, professional guest speakers, etc.), or work-integrated learning experiences (e.g., practicums and internships) to provide opportunities for students to contextualise their learning to reflect disciplinary or professional practice. Moreover, where appropriate, examine with students these contextualisation elements within the course as they relate to the broader program/degree of study. By doing so, it helps to motivate students to see where their knowledge can transfer, and what they can do with it now and in the future as professionals.
- Explore and integrate real-word problems as a vehicle to teach students about learning content as it is situated in the discipline. At the same time, also examine the analytical methods and techniques that occur in disciplinary/professional practice, and utilise those contexts and others with students to develop solutions to these real-world problems with the course learning content. By doing so, it helps students to recognise how learning content can be organised around general principles, which can then be transferred between contexts to solve problems. This is analogous to how experts and experienced professionals organise and apply knowledge.
- Facilitate integration and student thinking about course content across multiple contexts, including those in a student's real life (e.g., casual job, local community, weekly sporting team, or home life). Good quality learning can take place inside and outside of the classroom, even when transferred to unrelated and/or novel contexts.
- When developing courses, and even when in the flow of actually delivering a lecture, remain open to exploring with students the bi-directional relationship between academic and external contexts. For example, consideration could be given to how professional practice can influence course learning content, and how course learning content can influence professional practice. If applicable, tell stories to students of your experiences, and allow students to share their experiences.
- Retain the connection between subject matter and context throughout the learning process. Teaching efforts to detach subject matter from context (e.g., simplify a scenario into pieces of knowledge or facts) can sometimes be counterproductive for effective student learning. For example, when presenting a case study problem don't detach from it when exploring answers by focusing purely on de-contextualised knowledge; remain present in that context during your response or exploration of answers.
- The sharing or teaching of discipline knowledge in a contextualised learning approach can be both structured and/or dynamic in response to the demands of the context, and can resemble an authentic experience. For instance, if a student is on a practicum that is complemented by a set of lectures, all of the lectures can be made available online for a student to access out of sequence (instead of a weekly lecture series). In this manner, a student can access learning content when it is required in response to their learning needs that arise in practicum, and academic knowledge and theory development can become more situated in practice.
- Consider how to balance a student's constructivism in self-directing their contexualised learning experience and work together to co-create that learning experience. An example is giving students the agency to negotiate the learning activities in situated or practicum based learning experiences. Another example is to explore ways lecturers and students can work together to examine how learning activities in practice can align with learning/course objectives.
- Regularly consult and engage with relevant stakeholders across industry (e.g., government and representative professionals), community (e.g., NGOs) and alumni (e.g., graduates working in discipline) to examine how courses can remain current in how they contextually reflect practice, and how we can teach for working skills. Utilise these relationships to draw upon opportunities for industry to engage with courses and students (e.g., industry guest lecturers, in sourcing of workplace problems for learning topics or assessment items, and workplace student projects or practicums/internships).
- For situated or practicum-based courses, university teachers need to partner with organisations to align student experiences of these external contexts with course learning objectives. Furthermore, situated or practicum- based experiences should be created so that they are not predicated upon learners being framed as students. In these instances, students may engage in less optimal learning activities (e.g., data-entry and observations). These types of situated and practicum-based learning experiences need to appropriately challenge students, and lead to conceptual and skill development. If the experience is more predicated on learning as a student, rather than an evolving professional, then this can engender a less authentic experience for the learner as it is not indicative of the experience of the discipline.

Strategies for students

Students can leverage context to enhance their learning experience and outcomes by considering the following strategies during their learning experience:

- Be open to thinking about how course content can transfer contextually to other avenues of application, as well as to a chosen career path. This includes in the real world outside of academic contexts (e.g., casual job, local community, weekly sporting team, or home life), both when it is and is not formally facilitated by teaching staff. This will help to enhance the quality of learning and ability to recall information to perform on assessment/exams. Additionally, this will help to foster positive engagement with studies and engender self-reflective learning attributes.
- Try to seek out a variety of work-integrated learning experiences (e.g., practicums, internships, volunteer projects, etc.), both through university and outside of university.
- Attend industry events (e.g. networking meetings, public seminars, and conferences) to transfer/test acquired knowledge in informal work-related contexts, and aim for immersion in the culture and practices of that discipline.
- Remain open to exploring the bi-directional relationship between academic and external contexts. For example, how professional practice can influence course learning content, and how course learning content can influence professional practice.
- When studying for exams explore the learning content in different contexts. For example, instead of re- reading revision content, try to also imagine or apply the revision content in workplace scenarios. Another example might be to not only test progress via repetition of pre-defined revision questions, but to also construct different revision questions that examine the learning content in novel or unique scenarios. Finally, consider studying for exams in different places (e.g., home and library) and with different people.

Strategies for assessment

Assessment is an important part of the learning experience for students, and university teachers can utilise contextualisation to enhance assessment by considering the following strategies for assessment:

- Consideration should be made to explore ways assessment can be contextualised such that it reflects authentic and real-world contexts (e.g., workplace scenarios). This consideration can occur at any level of assessment. For instance, multiple choice questions have the potential for being contextualised in a similar way to essay questions.
- When considering the type of assessment items to employ in a course, consult with industry to understand the type of tasks/challenges professionals in that discipline experience, so that you seek to emulate that for student assessment items. For instance, in some courses a briefing letter may more authentically contextualise a written assessment item than an argumentative essay.
- Informal assessment can be very effective for student learning. This is particularly the case when it requires students to test their knowledge across different and novel contexts/scenarios. For example, if a student has to apply a concept in a tutorial practice test that requires application across a variety of contexts, students are more likely to perform better in an exam when tested on that concept in its unknown context.
- Having contextualised assessment is a step in the right direction, however, the benefits are enhanced for students with continuity between both contextualised learning and assessment together. Thus, it is ideal when authentic and contextualised assessment leads on from authentic and contextualised teaching.

Principle literature/theoretical overview

Context plays an important role in the way we learn and retrieve knowledge, whether that context is related to physical settings and/or is social-cultural in nature (Johnson, 2002; Smith & Mizumori, 2006; Tokuhama-Espinosa, 2010). University teachers can utilise context to enhance the quality and depth of how students learn, and consequently the ways students transfer and apply knowledge. The explanations and strategies that are proposed by this principle are theoretically centred around the concept of contextualised learning.

Identifying the constructs that underpin contextualised learning can be cumbersome. This is a result, in part, of the varying terminology used within the literature that relate to contextualisation and the construct conflation that exists in teaching practice, policy, and the literature. In some cases, different terminologies are interchangeable as there appear to be no substantial differences between the theoretical conceptualisations proposed. However, in other cases, while a common theoretical basis is shared between the different terminologies there are differing interpretations and implications. Common amongst the literature, as relevant to the proposition for this principle, is an emphasis for contextualised learning that is predicated upon learning experiences that are situated and/or resemble authentic and real-world contexts.

Key theoretical concepts that align with this principle's proposition of contextualised learning are situated cognition (see Brown, Collins, & Duguid, 1989) and situated learning (see Lave & Wenger, 1991). Collectively, these theoretical concepts underscore that learning is enhanced when knowledge and skill acquisition are embedded within relevant contexts that reflect their utility in real life (e.g., contexts that reflect the sometimes abstract and dynamic nature of real workplace/discipline problems), and also through integration with the social-cultural-physical environment of those contexts (e.g., practicum-based studies).

Another key theoretical concept that aligns with this principle's proposition for contextualised learning is authentic learning. In this sense there is an emphasis that student-centred learning can contribute to contextualised learning, insomuch as the relevance of a student's everyday lived experience also provides the perceptual relevance for students to contextualise their learning (e.g, students relating their learning to situations and problems they experience outside of the classroom), as opposed to solely external contextualised schemas being presented for students in which to artificially engage (Stein, Isaacs, & Andrews, 2004). Furthermore, from a distal theoretical perspective, this principle's proposition of contextualised learning also suggests some constructivist elements (Perkins, 1999; Steffe & Gale, 1995).

Commonly in practice and the literature, problem-based learning (Barrett & Moore, 2010; Duch, Groh & Allen, 2001) is also discussed alongside contextualisation, insomuch as it relates to the situated and authentic learning imperatives of contextualised learning approaches. For instance, problem-based learning requires an instructional approach that situates learning in an experiential manner around meaningful problems, which can authentically reflect the nature of the problems in the discipline, such as those which are contemporary and/or ill-structured (Barrows, 1996; Hmelo-Silver, 2004). Similarly, this is also the circumstance for case-based instruction (McCabe, Purcell, Baker, Madill & Trembath, 2009) and project-based learning (Bell, 2010). However, these approaches need to be used with caution. The research on the efficacy of pedagogical approaches that involve an element of discovery or exploration have been found to be less effective than direct instruction approaches in many instances (Kirschner, Sweller, & Clark, 2006).

Other common examples of theoretical constructs and terminology used include: Contextual teaching and learning (Johnson, 2002); context-based adult learning (Hansman, 2001); real-world learning (Brundiers, Wiek, & Redman, 2010); embedded instruction (Rakap & Parlak-Rakap, 2011); project-based learning (Bell, 2010); case-based learning (McCabe, Purcell, Baker, Madill & Trembath, 2009); and anchored instruction (Bransford, Sherwood, Hasselbring, Kinzer & Williams, 1990).

Finally, this is not to suggest that decontextualisation ought to be avoided. In fact, it can be the case that the interplay of contextualisation and decontexualisation as a process can contribute to the generation and abstraction of knowledge (Specht, 2008). Across all these theoretical underpinnings for contextualised learning, this principle endorses a functional interpretation whereby it is about optimising the learning design to find the appropriate dynamism between contextualisation and decontextualisation, given the learning objectives and constraints of the learning environment, to provide the most benefit for learning outcomes.

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“Emotions play a role in how and why students learn”

CHAPTER 3

EMOTIONS AND LEARNING

Explanation

Emotions are essential for and fundamental to learning. They are what drive students to engage in learning, influencing their levels of interest, their motivation to invest effort in their learning, their persistence with learning challenges, their desire for competence and growth, the quality and nature of their interactions with others, and their capacity to reflect effectively upon their learning. Furthermore, emotions are fundamental to key cognitive skills such as problem-solving, decision-making, and creative and critical thinking, all of which can directly influence learner attitudes, behaviours and achievement.

The way emotions inhibit or promote learning is complex. Learning experiences are always endowed with an emotional 'valence'. This valence associates that experience with an emotional state with positive emotional states being generally more conducive to effective learning than negative emotional states. This happens consciously and unconsciously, and is driven by the values attributed to the experience as well as the perceived outcomes. As such, individual and collective affect, and associated behaviours and learning, are influenced by these processes.

Learning experiences and contexts that spark curiosity, interest and wonder can activate the attention and reward networks of the brain, facilitating focus and making the experience pleasurable. Learning experiences and contexts in which a potential threat is perceived can activate a stress response, limiting attention to and focus on the learning. An awareness of the fundamental role played by emotions in the learning experience can support teachers to consider ways to effectively engage learner emotional states through learning design. For students, an awareness of the role of emotions in learning can assist in managing their responses, support the development of productive dispositions, and effectively identify and apply appropriate strategies. This merging of the cognitive and affective components of learning is what promotes motivation.

Motivation provides the drive, the energy and the direction for learning. Students whose motivation to learn is intrinsically driven - that is they are driven by mastery goals, personal interest, enjoyment - develop more productive dispositions for learning and attain better academic results. In contrast, extrinsic motivation reflects the drivers for learning that are contingent upon external influences to students (e.g., rewards such as praise, recognition and grades, or the elimination of potential punishments such as avoiding financial liability for failing a course). Intrinsic and extrinsic motivational attributions can operate both independently and simultaneously. For example, extrinsic motivation can be useful to resolve the initial challenge of engaging in a new learning activity, and thereafter intrinsic motivation can aid a student in persisting with the activity because they enjoy learning or value the experience or outcome.

Students' educational goals, sense of control over their learning, and dispositions around learning can influence their balance of intrinsic and extrinsic motivation. When students' goals for learning are based on demonstrating their ability, or proving themselves by competing with peers, their behaviour may become embedded in performance or achievement orientated goals. In contrast, when students' goals are based upon competence instead of competition, where they seek to improve and grow as a result of learning, they become embedded in mastery-orientated goals. When students are able to exercise some choice in the direction of their learning and the type of learning activities they undertake, the outcomes of their efforts to learn are felt to be within their own control. This fosters a student's development of an internal locus of control, and a sense of agency and autonomy in their studies.

Having a sense of control, and choice around their learning can help students develop positive dispositions towards learning, including perspective, persistence and resilience. These dispositions are essential particularly when learners experience challenges in their learning, such as when they encounter difficult concepts, negative feedback, or failure. Student emotional responses to these challenges can be quite negative: feelings such as frustration when confused; helplessness when not improving; or anxiety when undertaking an assessment, giving a presentation, or dealing with failure. An awareness of their own emotional response and the capacity to regulate this can promote more adaptive actions. Understanding the nature of emotion regulation in students is complex; however, the capacities involved in self-regulation can be developed through explicit guidance and practice. Self-regulation is discussed further in the theme *learning to learn and higher order thinking* in chapter 5.

Emotions do not just play a role in learning at the individual level: they are also fundamental to and influenced by the social dimensions of the university learning experience. Learning is a social experience. Be it on campus, in the workplace, or online, learning involves interactions of various forms with others. These interactions and the resulting emotions can impact upon a student's sense of belonging and relatedness to the learning experience and the place in which that learning occurs, and can also influence the nature and extent of learner engagement. Social interaction and connection can be advantageous in a variety of ways, for example: students can build a social identity with their peers and their university through interaction and connection; students are more likely to seek assistance from learning support services when they feel accepted and connected; and shared goals and purpose can motivate students to persist with a challenging task. More detail about social interaction and the experience of connection is discussed in the theme *interactive learning* in chapter 4.

Ultimately, the interplay of these broader affective factors upon student learning (including students' motivation, their learning goals, their sense of control over their learning, their dispositions towards learning, their sense of socio-emotional dimensions within their learning environment, and their experience and response to negative affect and psychological distress) can be positively impacted upon by the way university teachers consider their approaches to learning design, pedagogical practice, teacher-student interactions, and assessment.

Strategies for university teachers

University teachers can explore the role of emotions in learning by considering the following strategies when developing their learning and instructional design:

- Promoting a sense of belonging and relatedness within students to their learning environment can be achieved at a surface level through the incorporation of peer-assisted learning activities within and outside the classroom (e.g., group tasks and assignments). At a deeper level, it can also be effective to structure tasks so that students are encouraged to value one another by building trust and acceptance, establishing mutuality and inter-dependability in their learning goals, and frequency in their exchanges and meetings inside and outside of the classroom.
- Seek to build quality relationships with students. A student's sense of belonging and relatedness is a perception, and sometimes it is the meaning derived from a student's engagement with a lecturer that is of most value, and not just the amount of time spent with a lecturer. This means when a teacher does get the time to engage with students, whether in a group or individual format, students should feel they are valued and heard, and that they can relate to, or know, their teacher in some way. For instance, in a large course where the coverage of teacher-student exchanges is limited, they can establish their accessibility and presence once or twice throughout the semester by briefly visiting the small class tutorials to create a short dialogue with the tutorial. Teachers can also incorporate personal stories into the delivery of learning content, or describe their experiences from when they were a student exposed to similar learning content.
- Help to assure students' perceived effort to reward relationships by making transparent the course design, as well as ensuring that arbitrary or bureaucratic elements (e.g., academic penalties/policies) do not undermine the fidelity of these relationships. For instance, this could mean explicitly and regularly linking learning activities to learning objectives with students. Furthermore, it would be beneficial to prevent task ambiguity and check the accuracy of students' task clarity. If task ambiguity is intentional, the pedagogical reasons for this need to be explained to students (e.g., the role of confusion and disequilibrium as indicative of some professional contexts). This could also mean explicitly exploring issues with students around assessment deadlines, academic integrity policies, and academic penalties.
- Students' affective experiences of a course are subjective and difficult to gauge without feedback. Try not to overly interpret attendance as an indicator, as this can be a conflated measure. Instead, be alert to verbal and non-verbal cues such as body language, tone of voice, and valence of language around learning; explore ways to actively seek feedback from students during and after a course to hear about their perceptions of their affective experience; incorporate journals or blog posts as formal or informal assessments to capture

cognitive challenge and strategies for resolution. Develop positive relationships with a sample of students and informally speak with them to gain their feedback. Alternatively, advances in educational technology and learning analytics can also offer valuable avenues to explore students' affective experiences. Use this information to decide how, and if, the learning design or instructional approach can be adapted to enhance students' affective experience.

- Explore with students how they can regulate their emotions when learning to improve their experience and outcomes. For example, help students to recognise different emotional states (e.g., exam anxiety or statistics anxiety) and feelings (e.g., frustration or disappointment) and engage in strategies to abate those emotional states and feelings (e.g., reducing perceptual focus on those feelings).
- Try to promote a positive and enjoyable course culture that involves fostering students to have situational interest in the learning environment, and find ways to maintain this throughout the course so that students are more likely to develop an enduring personal interest in the course. Furthermore, explore ways that cultural expectation can precede the course. For instance, encourage current students to tell other incoming students about their positive experiences of the course. Alternatively, if there is a notion or reputation for a course as being hard or having a high fail rate, then address that with incoming students. For example, explain why it might be perceived as hard and what might be some useful strategies, or if the perception of fail rates is incorrect, present students with the accurate pass rates.
- Foster students' perceptions of their autonomy and agency by providing them with flexibility and choice (e.g., elements of a personalised learning pedagogy) in course learning topics, activities, and assessment. Furthermore, where students do already have flexibility and choice within a course, underscore this and make it salient to them.
- Encourage students to develop emotional resilience by engaging in a dialogue with them that reflects the malleable nature of their abilities and their capacity to improve through appropriate actions. Additionally, explore vicarious examples of persistence with learning even when it is difficult and challenging (e.g. model to students examples of your own learning outcomes from experiences that required persistence, hard work and effort).
- Embrace error, and recognise failure as a powerful learning strategy through incorporating formative feedback at regular time points over the semester and providing students with the opportunity to revisit misunderstandings and inaccuracies.
- Encourage students to develop their self-efficacy, or beliefs about their own ability to accomplish learning related activities, by having them set and explore mastery-related goals that are clear, specific, and realistic.
- In a larger course with guest lecturers and many tutors, where considerations around broader affective factors have already been incorporated into a course learning design and instructional approach, make this explicit to others in the teaching team as the intended pedagogical purpose can be easily missed.
- Gain knowledge of external support services for students so that if they are experiencing psychological distress, or seeking help, you are able to appropriately refer them to help or assistance.

Strategies for students

Students can explore the role of emotions in learning by considering the following strategies during their learning experience:

- Self-reflect and examine the nature of self-imposed learning and study goals, and seek to explore if mastery-related goals may be more useful than performance-orientated goals.
- Self-reflect and examine perceived malleability of learning-related abilities, and seek to explore strategies for emotional resilience.
- Actively engage with other students in the learning environment both within, and outside the classroom, to help grow a sense of belonging and connectedness. By doing so, seek to discover how peer relationships can be formed through being open to shared experience and committing to mutual goals. This can also extend to a variety of other social agents in the learning environment (e.g., lecturers).

Strategies for assessment

Assessment is an important part of the learning experience for students, and university teachers can explore the role of emotions in learning by considering the following strategies for assessment:

- To encourage both resilience and students' beliefs in their ability to perform, offer feedback dialogues that are specific, timely, developmental, and outline how to improve. Avoid giving feedback that is deterministic or offers absolute judgement. Additionally, explore the manner in which grading can be developmental (e.g., a grading label of 'fail' could be replaced with 'not yet passed').
- Explore a course approach that focuses upon a paradigm of explicitly communicating high expectations about students' ability to perform, offers low stakes and regular assessment, and provides opportunities for high support though frequent developmental feedback.
- Seek to balance the provision of public awards for a course that are not just related to high academic achievement. Examples could include an award that focuses upon impact or innovation achievement, or alternatively have awards situated within external contexts of the community and industry that emphasise professional character attributes instead of just performance.
- If students have failed a course, or the cohort has received a large amount of low grades, prepare students for the news. For instance, email students that have failed, at the same time as grades are released, with a more personalised brief dialogue that encourages them to read assessment feedback and engage with teaching staff for further support if needed.

Principle theoretical/literature overview

Emotional responses are essential for effective learning. In the learning environment, emotions are both experienced as well as instrumental to personal growth and academic achievement (Linnenbrink-Garcia & Pekrun, 2014). Emotions are essential for and fundamental to effective learning as they are integrated with key cognitive skills and psychological states such as attention, memory, decision-making, motivation, interest, engagement, persistence and social functioning (Immordino-Yang & Damasio, 2007; Linnenbrink-Garcia & Pekrun, 2014; Pekrun, 2006). Whilst emotions surrounding learning are highly complex due to their subjective nature (Immordino-Yang, 2011), an understanding and appreciation of their role in learning can be leveraged to inform the design of engaging learning experiences (Immordino-Yang & Damasio, 2007). Furthermore, emotions are also directly involved in and have an influence upon teaching. Therefore, designing and delivering effective learning experiences requires an awareness of both teacher and learner emotions and an understanding of how these can be harnessed to promote personal and academic growth and achievement.

Emotions are dynamic, multidimensional constructs, composed of affective, psychological, cognitive, expressive, and motivational components. They can be a momentarily experienced state, such as excitement or fear, or a personality trait – an individual's consistent response across a range of situations (Frenzel & Stephens, 2013). Traditional theories of emotions propose that they are evoked in response to the perception and interpretation of a subjectively relevant trigger – which can be real or imagined – and this then leads to a physiological response that shapes behaviour and affect (Immordino-Yang & Damasio, 2007). Emotional experiences encompass a whole-body phenomenon with an ongoing feedback loop between sensory perception, emotional arousal and physiological response (Immordino-Yang & Damasio, 2007) – that influences thoughts and feelings, and manifests in a range of verbal and non-verbal behaviours and cues such as facial expressions, prosody, and body language (Frith & Frith, 2008). These affective and behavioural responses can influence both the individual and those with whom they interact. The emotional state of the learner can influence the emotional states of others (learners and teacher) through processes of contagion, imitation, group affect, empathy and self-representation. It is important for teachers to be conscious of this influence, and in particular, how their own emotional state can influence the affective dynamic of the classroom and the learning experience. Modelling positive, affective states can promote learning through the communication and contagion of teacher passion, interest, engagement, curiosity, and wonder. This social dimension of learning is one of several ways in which emotions can influence learner outcomes.

Pekrun's (2006) control-value theory of achievement emotions proposes that there are both antecedents and consequences to emotions in the learning context relating to achievement activities and achievement outcomes, topics, personal epistemologies, and incidental contexts, as well as the social contexts as mentioned above. Affective appraisals and responses surrounding learning are highly complex due to their subjective nature (Immordino-Yang, 2011). The valence of an emotional response can promote or impede learning: strong negative emotions can increase awareness of the difficulty of a task, interrupt cognitive function due

to the activation of the stress response, and promote negative psychological and physical consequences, whilst positive emotional states can broaden awareness, enhance creative and flexible thinking, increase perspective taking, and promote persistence (Fredrickson, 2007). However, this dichotomy of emotional valence is not that simple. Complex learning experiences frequently elicit potentially negative emotional states of uncertainty and confusion: subjective states which, when resolved through appropriate scaffolding, are essential for deep learning (Lodge, Kennedy, Lockyer, Arguel & Pachman, 2018). Understanding the triggers and role of emotions in learning can assist in the design of effective learning experiences that can promote positive learner behaviour including motivation, engagement and persistence.

Emotions can initiate behaviours through motivational processes (Frenzel & Stephens, 2013). Motivation is the underlying psychological process that links affective and cognitive components resulting in behaviours characterised by energy and direction (Ainley, 2012; Pekrun, 2006). Motivation is frequently associated with engagement, which in the learning context is defined as the connection a learner has to the content, the associated learning activities, and those within the learning environment (Suarez-Orozco, Sattin-Bajaj, & Suarez-Orozco, 2010). Central to both motivation and engagement is interest, which can be triggered or maintained through a learning situation or may emerge and develop at an individual level (Hidi & Renninger, 2006). Interest can sustain motivation and engagement, and therefore serve a self-regulatory function (Ainley, 2012). A student's level of interest – and therefore their motivation and engagement - is linked to both the perceived value of the task or learning experience and the level of control they feel they have over the experience and the outcome (Pekrun, 2006). Students who appraise a task as valuable and achievable, who have high self-efficacy, or who are driven by mastery goals are more motivated than students who are performance-goal driven and who perceive less control over the process and outcome (Martin, 2007). A range of executive functioning skills, including attention, planning, problem solving and emotions, supports goal-directed behaviour. These skills are all called upon to facilitate self-regulated learning. For more information on self-regulation, refer to the theme *learning how to learn and higher order thinking* in chapter 5.

An understanding and appreciation of the role of emotions in learning can be leveraged to inform the design of engaging learning experiences (Immordino-Yang & Damasio, 2007). In a higher education context, this might include activities that provoke curiosity and interest, using contemporary issues to promote discussion and debate, modeling passion and wonder in teaching, or using humor to influence the valence of the classroom environment. Supporting the development of intrinsically motivated tertiary learners involves appropriate challenge, high expectations, the engagement of positive emotions, recognition of prior knowledge and experiences, and the inclusion of autonomy and agency.

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"The social dynamics of learning can be leveraged to enhance the learning experience"

CHAPTER 4

INTERACTIVE LEARNING

Explanation

Learning by university students is situated in, and enriched by, their social interactions with others. Social interaction, which involves a range of conscious and unconscious processes, directly influences learner engagement and achievement, and can be leveraged to enhance learner efficiency, co-creation of knowledge, innovation, and collaboration to find solutions to complex learning problems.

University learning involves diverse forms of interaction, be that face-to-face or online, and frequently the learning occurs in groups of varying size. The success of these groups, and of the individuals within them, is influenced by the nature and quality of the social interactions that occur within and around them. Effective groups are shown to be highly connected: individuals 'tune in' to the actions, thoughts and feelings of others in the group, sharing their emotional, cognitive, and physiological states, and this leads to a wider sense of connection, understanding and communication. This process is facilitated by the innate mechanisms of social cognition, and by the design of the external environment in which these interactions take place.

A range of conscious and unconscious processes are involved in connecting with and understanding others in a social context. Processes that enable the self-representation of the actions, behaviours and emotions of others, along with the capacity to understand or appreciate the perspectives and experiences of other people, assists individuals to shape and respond to interactions. When students are provided with carefully designed and structured opportunities to interact they typically also seek to understand others actions, thoughts and feelings. Developing this shared understanding can establish a sense of connection or synchrony. In doing so, students then modify their own behaviours to coordinate mutually in both supporting and complementing each other, to achieve a common learning goal. As a result, this type of social and cognitive synchrony is an elaborated process that can involve cognitive elements (e.g., understanding someone's assumptions), behavioural elements (imitation or contagion of behaviours or body language), and affective elements (e.g., sharing a sense of optimism). This synchrony is also evidenced physiologically, for example with feelings of shared anxiety prior to a group assessment. A sense of connection with others – of being on the same wavelength – is, therefore, more than just a figure of speech: it represents the experience of a shared understanding which comes through social interaction.

Rich social interactions such as those evident in active learning environments can provide students with opportunities to clarify, consolidate, challenge, and expand their mental models and representations (e.g., elements of distributed cognition), co-construct knowledge, and cultivate deep thinking. This occurs through exposure to a diversity of perspectives, thoughts and ideas, which may or may not align. This diversity represents others' prior knowledge that can derive from a variety of experiences (e.g., subject familiarity, discipline background, and/or culture), as well as others' various aptitudes for higher order thinking.

Learning and teaching are highly social activities, and the innate processes underpinning social cognition are fundamental to the effectiveness of these experiences. While aspects of these processes and skills may be innate or intuitive, a greater awareness of them and how they can influence a sense of connection in social interactions can assist in establishing more positive social environments. In a learning context, these capacities can be leveraged to promote learning. Enhancing the social dynamic and interactivity of the learning environment can enhance the efficiency with which students learn, allowing students to innovate and co-create knowledge through a diversity of thoughts, and effectively collaborate with others to find solutions to complex learning problems.

A highly effective social pedagogical practice that has been found to have positive affective and cognitive outcomes for university learners is cooperative learning. Cooperative learning involves the design of clearly articulated and scaffolded small group tasks in which each individual has a dual responsibility of not only their own role, but also that of monitoring the roles of others within the group. Each member of the group has a shared understanding of the goals of the group and of their roles and responsibilities within that group. Cooperative learning is an effective way in which learners can co-construct new knowledge. Through dialogue and discussion, participants can co-construct a shared understanding or shared meaning, creating a sense of connection, synchronicity or inter-subjectivity between individuals.

Through group learning, cooperative learning or other processes of co-construction can foster students' learning by helping to shorten the time it takes to complete learning tasks, and increase the relative difficulty or complexity of learning problems that students are capable of undertaking. More specifically, when this occurs, more cognitive resources can be directed towards the learning task, as the load on working memory and social cognition are reduced. Furthermore, it has been suggested that increased synchrony, under the right conditions, can also promote something of a collective intelligence factor, which enhances the capability of students beyond simply their combined relative individual capabilities, so that they can solve complex learning tasks.

The power of social interaction as a force for effective learning is frequently overlooked or left to chance. However, an appreciation of the processes of social interaction and cognition can enable teachers to engineer highly connected learning environments that promote understanding and achievement. For teachers, interaction with learners enables their understanding of the cognitive, social, emotional and physical needs of students, and this understanding can then be used to provide the appropriate scaffolding and support needed to promote achievement. For learners, interaction with peers in the learning context can provide academic, social, emotional and physical benefits. The social dynamics of learning can positively influence the broader affective experiences of learning for students and for teachers (e.g., socio-emotional dimensions of belonging, relatedness, and connectedness). This is explored further in the theme *emotions and learning* in chapter 3.

Strategies for university teachers

University teachers can explore the social dynamics of learning by considering the following strategies when developing their learning and instructional design:

- Find ways to promote the social interactivity of students' learning experience with diverse peers. At a simple level, this can mean incorporating peer-assisted learning activities into lectures and/or tutorials. At a more extensive level, this can mean having students engage in interdisciplinary courses, or projects, that involve a variety of students from different degrees learning together (e.g., health students learning with IT students to collaboratively develop a health promotion smartphone app).
- Explore ways to facilitate a classroom culture that attempts to foster shared meanings, values, and beliefs between students, and is perceived as a safe and secure environment for students to interact and collaborate.
- Appreciate that effective collaboration for students with one another on learning tasks can take time. Try to balance the extent of varying the diversity of students' social interactions with the need to develop connections with each other. For example, if having students rotate for a group activity, instead of having all students rotate individually have them remain in a dyad, and rotate the dyads.
- Even when students are at a perceived early stage of learning about a topic (e.g., first-year students, or first weeks of a course), and are developing their mental models and representations, they should still be given ample opportunities to explore their perspectives through social interactions with peers.
- Evolving educational technologies can both aid, and hinder, the social dynamics of students' learning experiences, as well as influence the permanence of social barriers. It is important for university teachers to explore how educational technologies are used, and then assess the beneficial or non-beneficial impacts upon the social dynamics of learning.
- Promote students' capabilities to socially interact with each other in an effective manner by exploring ways to develop their written and verbal communication skills, as well as their social skills, through lectures and tutorial learning activities. For instance, this can mean asking students to explore the learning dialogue they have with others (e.g., elaborate on their responses even if correct).

Strategies for students

Students can explore the social dynamics of learning by considering the following strategies during their learning experience:

- Self-reflect upon how social interactions enrich the diversity of perspectives encountered, and what this means for learning and thinking. Additionally, self-reflect upon how communication and social skills can be used to enhance the social dynamics of exchanging perspectives with others.
- Explore opportunities to enrich the social dynamics of learning by engaging in socially diverse learning experiences. For example, take elective courses in other disciplines to engage with diverse student knowledge-bases, or enroll in international exchange opportunities with external universities.
- Appreciate that effective collaboration and cooperative learning on tasks can take time, and it is often not immediate. With that in mind, try to exercise patience and be open minded towards interactive learning tasks (e.g., group activities) as a learning opportunity to expand conceptual knowledge, ways of thinking, cooperative skills, and communication/social skills.

Strategies for assessment

Assessment is an important part of the learning experience for students, and university teachers can explore the social dynamics of learning by considering the following strategies for assessment:

- Where possible, incorporate a variety of socially interactive learning assessments in a course (e.g., group assignments and/or peer marking) that align with the learning content and objectives.
- In socially interactive learning assessments, include a self-reflective element that requires students to examine the social dynamics of the assessment, and the impacts upon their learning and thinking.

Principle theoretical/literature overview

The capacity and desire to interact socially, connect and therefore understand others is innately human and is an essential requirement of survival (Immordino-Yang & Damasio, 2007; Lakin, Chartrand, & Arkin, 2008). Social interaction and cognition are also fundamental to human teaching and learning (Battro, 2010; Strauss & Ziv, 2012). Learning – and teaching – are highly social activities: whether face-to-face or in an online environment, and engage a range of conscious and unconscious skills and processes that can be harnessed to positively impact learner outcomes. During social interaction, such as that between student and teacher or between students, conscious and unconscious processes support the collection and interpretation of various social cues, which shape individual responses (Barsade & Gibson, 2012; Keysers & Gazzola, 2007; Lakin et al., 2008). These processes shape an individual's understanding of the context and of those within it (Cacioppo & Cacioppo, 2012; Harmon-Jones & Winkielman, 2007). Social understanding is facilitated by three interrelated routes: Action understanding, Empathy and Theory of Mind (Klimecki & Singer, 2013).

Action understanding involves the self-referencing of another's observed behavioural or emotional state through neural simulation (Uddin, Iacoboni, Lange, & Keenan 2007). This process can result in the vicarious experience of another's state, enabling empathy, a capacity essential for social understanding (Klimecki & Singer, 2013). Empathy - the ability to share and understand other people's affective and mental states – is fundamental for positive social interaction. The capacity to attribute mental states (beliefs, intent, desires, attitudes, thoughts, feelings, knowledge, pretense) to other people, and to understand that others may have mental states that are different to one's own is known as Theory of Mind (Flavell, 2004; Singer & Decety, 2011), and this capacity has been shown to be essential for effective teaching (Battro, 2010; Strauss & Ziv, 2012). Through these three interrelated routes, individuals can better understand, interpret and shape responses to interacting partners in social settings and create a sense of interpersonal connectedness, shared understanding, or synchrony. An awareness of these processes can provide teachers with avenues through which to influence the social dynamic of the learning environment. The deliberate modeling of positive affect and social behaviours by the teacher has been shown to have a direct influence on the overall affective state of the group or class, and the valence of group affect significantly influences both individual and group effectiveness and achievement (Barsade & Gibson, 2012).

The capacity to understand others and to share their emotional, cognitive and physiological states results in a deep sense of connection known as social synchrony, which is evident at behavioural, emotional, physiological and neurological levels (Farmer, Dawes, Alexander, & Brooks, 2016; Holper, Goldin, Shalom, Battro, Wolf, & Sigman, 2013; Wheatley et al., 2012). Social synchrony is an innate, embodied form of socially connecting and communicating on a wider scale to support a shared goal or purpose (Farmer et al., 2016; Wheatley, Kang, Parkinson, & Looser. 2012). The experience of shared states facilitates more cooperative, pro-social behaviours, building group cohesion, trust and rapport, and increasing a sense of connection to the learning experience (Wheatley, et al., 2012). While social synchrony can occur spontaneously through observation, imitation or contagion, it can also be engineered (Rodriguez, 2012; Wheatley et al., 2012). Communal learning spaces contain a natural social dynamic which can be deliberately harnessed through the design of social learning experiences, enhancing a range of social, emotional and cognitive outcomes for both learners and teachers (Farmer et al., 2016).

Synchrony or shared understanding can be developed through pedagogical practices that promote the co-construction of knowledge and joint awareness. Co-construction is differently defined, depending on the theoretical frame. However, across all definitions similarities exist in terms of the implication of a social or collaborative activity using language as a mediator undertaken in order to achieve a shared or synchronised understanding (Reusser & Pauli, 2015). Interpersonal interactions support intrapersonal processes, particularly when these interactions occur between individuals of differing capabilities. A more knowledgeable or capable partner (i.e. a teacher) tailors a task for their less capable partner by providing appropriate scaffolding and support to enable the acquisition of required knowledge or skill. This zone between what an individual can do with support and what they cannot do alone is known as the zone of proximal development (Vygotsky, 1962). Modeling and scaffolding through the provision of strategies or hints are ways in which teachers can guide students through the steps to understanding. They can also elicit reflections, responses, elaboration and explanations from students in order to articulate what is understood and what is still a challenge (Chi, 1996). Another highly effective way through which knowledge can be co-constructed between students is using cooperative learning strategies.

Cooperative learning – the pedagogical practice of working interdependently in small social learning groups towards the attainment of a shared goal (Davidson, 2002; Gillies, 2007) – is one way in which this social dynamic can be harnessed. Compared to group instruction, cooperative learning practices in the university setting enhance engagement and participation, increase motivation, have greater innate task value, and provide opportunities for appropriate learner challenge (Peterson & Miller, 2004). University students learn best when they are fully engaged – cognitively, emotionally, socially and behaviourally – and when they have the opportunity to immediately apply new knowledge and skills to what they already know. However, effective cooperative learning must be carefully designed to ensure that students have the appropriate social interaction skills to work effectively together. This includes ensuring students have clarity around the task, and that they feel competent in their own and the group's ability to complete the task (McWhaw, Schnackenberg, Sclater & Abrami, 2003). To facilitate this, learners need to be provided with social learning opportunities where they can get to know and understand others.

Interacting with others can promote a range of essential benefits including wellbeing, group productivity and achievement (Arena, Pentland & Price, 2010; Barsade & Gibson, 2012; de Gelder & Hortensius, 2014; Yano, 2013). Understanding the processes underpinning social learning can assist in designing learning opportunities that capitalise on the innate human desire to socially interact.

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"When students employ effective methods of thinking, and understand how they learn, they can improve the way they learn"

CHAPTER 5

LEARNING TO LEARN AND HIGHER ORDER THINKING

Explanation

A high-quality learning experience involves students employing effective methods of thinking to learn and solve problems. The methods of thinking which are of most pedagogical impetus are higher order thinking skills, which can include thinking critically and creatively about learning content and problems. Despite conventional beliefs, students have the capacity to improve their ability for higher order thinking, as well as improve their ability to self-regulate their learning. This capacity to improve can occur through natural maturation and lived experiences, but can also be enhanced by the way students experience design for learning and assessment engineered by university teachers. Improvements in higher order thinking and self-regulation of learning are important for students' educational success, leading them to think more broadly and deeply about their learning, enhance their ability to identify problems, and improve the quality of solutions they can produce. This can also translate to benefit students' workforce effectiveness and quality of life by enhancing the value that students can derive from knowledge and what they can achieve with that knowledge.

A key aspect of higher order thinking is the ability for critical and creative thinking. Critical and creative thinking are sometimes conceptualised as non-disparate cognitive processes depending on how a student engages with a problem (i.e., thinking critically and creatively at the same time about problem elements). However, they do diverge in some regards in terms of their pedagogical focus. Critical thinking involves a variety of cognitive efforts that extend to identifying, clarifying and structuring knowledge as it applies to learning content and problems, and employing inductive and deductive reasoning. It also encompasses a key evaluative element in terms of judging the validity and reliability of assumptions, data and/or information available, and problem solutions. Creative thinking does converge with some of the above aspects of critical thinking, however it has a greater focus upon the generation of ideas, methods, and/or processes that are novel and relevant. Neither critical nor creative thinking are wholly innate skills; instead they can be the products of conscious action and disciplined- systematic thinking.

Self-reflection is another powerful cognitive activity engaging higher order thinking. When students engage in self-reflection confined to the context of the learning problem, it remains within the domains of critical and creative thinking. This transition into self-reflection upon how they are thinking about their thinking, and resultant actions taken on the basis of this thinking, shift students into self-regulation of their learning. Self-regulated learning can encompass a broad range of interrelated factors. A key factor is students' metacognitive awareness (i.e., thinking about one's thinking) and how that relates to their learning. This can include information about what one knows about why they think or how they learn; what one knows about the learning procedures and strategies that are ideal for them; and what one knows about the conditions in which these cognitive actions work best. Another key factor is the regulatory actions students take to promote their learning. This can include activities related to planning cognitive tasks; monitoring one's own progress throughout those cognitive tasks; and making evaluative judgements about whether the processes used were effective in promoting learning and performance to the desired level.

Self-regulated learning can also include the regulation of students' emotions related to learning (e.g., sustaining motivation). As students learn to regulate their emotions during learning, a dispositional shift can occur where challenge is sought and they become comfortable with being uncomfortable. This might involve students' regulating their self-talk related to negative learning responses (e.g., apprehension, frustration, and/or boredom) and positive learning responses (e.g., curiosity and enjoyment). These aspects of emotional self-regulation are within a student's internal control. External factors related to emotions in learning are further explored within the *emotions and learning* theme in chapter 3.

Higher order thinking skills, as well as self-regulated learning, can be embraced through a teaching emphasis that extends beyond just the solutions or answers to learning problems, and instead systematically develops students' thinking and learning strategies in response to learning problems. This might mean explicitly teaching methods of inquiry, such as exploring with students what is meant by explaining, analysing, applying, justifying, or evaluating; what are their respective inquiry methods; and how do they converge and diverge. Carefully engineered learning activities – in which students may be challenged, confused, or get the wrong answer – provide opportunity for students to engage in critical and creative thinking. This requires relevant scaffolding and learning guidance, in which the timing, sequence, direction and/or type of teacher and peer feedback is critical. Further, the learning benefits of higher order thinking for students can be enhanced with consideration of the social interactivity of the learning environment. Creating opportunities for students to explore and develop their higher order thinking can come at some dispositional and cognitive cost, and appropriate learning room, or flexibility, and supports need to be created within the instructional and learning design. This learning room could extend to giving students the opportunities to experiment and test solutions under the appropriate boundaries, providing sufficient learning time, giving them opportunities to reflect upon their learning, and establishing feedback pathways for learning support. Refer to *interactive learning* in chapter 4 and *learning challenge and difficulty* in chapter 6 for further explanation of these concepts.

When students engage in higher order thinking, as well as self-regulated learning, it helps to shift them from passivity to active engagement with their learning. A common misconception about higher order thinking is that students must be gradually exposed to complex problems. Students are capable of higher order thinking and complex problem solving at any iteration of knowledge acquisition with correct design scaffolding, whether at the beginning or end of a course, or in the first year or third year of university.

Strategies for university teachers

University teachers can explore students' higher order thinking and self-regulated learning by considering the following strategies when developing their learning and instructional design:

- To foster students' critical and creative thinking skills it is important to spend teaching efforts exploring, challenging and directing students' methods of thinking. An inquiry-driven teaching approach (e.g., problem-based learning) allows teachers to focus on helping students with their methods of thinking in the analysis and synthesis of learning content and problems, as well as providing guidance to reach the correct answer. For instance, help students to deconstruct, explore, appraise, and reconstruct problems in both accurate/expected and inaccurate/non-expected ways. In doing so, it is also important to appraise that students have sufficient prior knowledge to engage in these kinds of activities.
- Encourage students to challenge the content they learn about in multiple dimensions. For example, 'Why do I think that?' 'How do I know that?' 'How else could this be applied?' 'How else could this be thought about?' 'What are the limits or extremes of application?' 'How else would other people think about it?' Essentially, this means encouraging students to critically question and challenge assumptions, prevailing beliefs, and methods. In doing so, students can become more creative by generating new parameters and alternatives, and considering their relevance to existing conceptual knowledge and overarching theory. Likewise, university teachers can model aspects of this type of thinking to students by demonstrating and discussing their own thinking.
- Encourage students to generate multiple and varying ideas and proposals when solving problems and then critically explore their respective advantages and disadvantages to test, refine, and re-apply (e.g., design thinking paradigms).

- Strategically use the repertoire of labels related to higher order thinking skills when teaching and assessing students, and moreover, explicitly teach them to students. For example, explore with students what is meant by explaining, justifying, analysing, synthesising, applying, and/or evaluating; what are their respective methods and how do they converge and diverge.
- Promote students' ability to self-regulate their learning by supporting them to gain greater metacognitive awareness about their learning. This can include:
  > Helping students to gain awareness about why they think about learning topics or problems the way they do, and how that influences the way they learn;
  > Helping students discover what learning procedures and strategies (e.g., methods of thinking) are effective and how to judge the effectiveness;
  > Helping students determine the conditions in which these cognitive actions work best.
- Support students to exercise and employ greater regulatory actions to promote their learning based upon their metacognitive awareness. This can include:
  > Helping students plan their cognitive processes or steps (e.g., learning procedures and strategies) when learning about a topic or solving a problem;
  > Helping students monitor their progress throughout those cognitive processes;
  > Helping students make evaluative judgements about whether the cognitive processes they are using are effective in promoting learning and performance to the desired level and to take corrective actions if not.
- Facilitate students to become more adept at dealing with, or self-regulating, the emotional aspects of their learning experience to their advantage. This can be achieved by helping students to recognise what emotional aspects they experience when learning (e.g., curiosity, enjoyment, apprehension, frustration, boredom), under what conditions they can be useful and less useful, and how to enhance and/or abate their emotions to serve their learning desires (e.g., regulating internal self-talk during learning).
- Utilise cues that signal to students when the learning content and activities are likely to require a focus upon higher order thinking so that students can prepare for how they self-regulate their engagement (e.g., self-regulate their attention).
- To promote critical and creative thinking, ensure learning content and activities have sufficient complexity and that flexibility is built in to allow students to experiment, take risks, collaborate, and self-reflect. Also, seek to provide students with learning support through pathways such as teacher and peer feedback, which has been considered for its timing (e.g., immediate or just-in-time), sequence (e.g., scaffolded), and direction and/or type (e.g., task feedback, process feedback, or self-regulatory feedback).
- Appreciate that when students engage in higher-order thinking it can be challenging (i.e., cognitively and/or emotionally). In this case, try ensuring the efficiency of students' learning experience (e.g., ensuring task clarity, reducing irrelevant learning content and non-pedagogically focused instructional distractions, and discouraging unnecessary multitasking).
- Engaging students in a learning environment with rich social interactions can provide them with opportunities to consolidate, challenge, and expand their mental models and representations, and develop higher order thinking as well as cultivate avenues to develop their ability to self-regulate learning. For instance, explore how student opportunities for self-directed learning can be integrated with socially interactive learning or practice, and when and how they best complement each other (e.g., Flipped Classroom teaching approaches). Additionally, to help students reap these benefits from their social interactions it can be important to also attend to their ability to communicate their thinking (e.g., in written and verbal form).
- When promoting the study of lecture content for exams, encourage students to explore and experiment with a range of study strategies. This will enhance opportunities for students to develop their higher order thinking, as well as give them further resources to draw upon when self-regulating their learning. For instance, practice testing, elaborative interrogation and self-explanation can be more effective for fostering higher order thinking than other approaches such as summarisation and serial re-exposure to learning content (e.g., re-reading/re-watching).

Strategies for students

Students can explore their higher order thinking and self-regulated learning by considering the following strategies during their learning experience:

- Challenge how content is considered across multiple dimensions, questioning and challenging assumptions, prevailing beliefs, and methods. For example, 'Why do I think that?' 'How do I know that?' 'How else could this be applied?' 'How else could this be thought about?' 'What are the limits or extremes of application?' 'How else would other people think about it?'
- Appreciate that being an effective thinker is about effective methods of thinking to learn and solve problems. This involves not only reflecting upon the strengths and weaknesses of the solution to a problem, but also reflecting upon the strengths and weaknesses of the thinking processes or strategies used and their relative effectiveness. Additionally, testing ideas, getting answers wrong, and being confused are all parts of an effective method of inquiry, and those experiences merely serve as further information to advance thinking.
- Self-regulate learning by:
  - > Thinking about why learning topics or problems are interpreted in a particular way, and how that influences the way learning occurs;
  - > Considering what learning procedures and strategies (e.g., methods of thinking) are most effective, personally;
  - > Determining the conditions in which these cognitive actions work best;
  - > Planning cognitive processes or steps (e.g., learning procedures and strategies) when learning about a topic or solving a problem;
  - > Monitoring progress throughout those cognitive processes;
  - > Making evaluative judgements about whether the cognitive processes used are effective in promoting learning and performance to the desired level, and take corrective actions if not.
- Seek to make evaluative judgments about personal capabilities or performance at any stage of learning (pre or post formal assessment). This means developing the ability to make evaluative judgements in a rigorous way by producing learning criteria that are precisely defined and coherently applied upon valid sources of learning evidence.
- View university teachers as potential sources of not only corrective feedback, but more importantly, inquiry-driven guidance and feedback, as this can lead to more discovery on the way to expanding personal learning. This might mean asking questions about problem reasoning (e.g., asking about assumptions surrounding a theoretical premise to an essay argument, instead of asking for the correct theoretical premise).
- Appreciate university teachers as facilitators of knowledge rather than an absolute source of knowledge. In doing so, take responsibility to critically examine the discipline knowledge offered by university teachers and develop a personal epistemology around that discipline knowledge.
- Approach learning as if the purpose was not only to perform well in a test, but also to teach it. In doing so, examine how learning relates or contrasts to other known/unknown contexts and application pathways. In this way, it creates the challenge of thinking more critically and creatively as topics are learned and explored.
- When studying lecture content and preparing for exams, explore and experiment with a range of study strategies to see what is most effective – which may not be the easiest. For instance, try practice testing, elaborative interrogation, and self-explanation, as these can be more effective than other approaches such as summarisation and serial re-exposure to learning content (e.g. re-reading/re-watching).

Strategies for assessment

Assessment is an important part of the learning experience for students, and university teachers can promote students' higher order thinking and self-regulated learning by considering the following strategies for assessment:

- When designing assessments or introducing assessments to students, it is important to actively involve students in the creation or comprehension of the assessment criteria, as well as the application of the assessment criteria. In this way, it helps students identify, make sense of, and own the criteria that they need to apply to their own learning tasks or work, as well as their capability to make more robust evaluative judgements.
- When exploring assessment criteria with students, provide specific descriptions and exemplars that demonstrate the relevant aspects of the assessment criteria. In this way, it helps students to comprehend the standards associated with assessment criteria. Alternatively, in a peer-assisted learning approach, this could mean students collaboratively explore and develop criteria for an individualised learning task, and then also take the opportunity to informally mark each other's work using the criteria.
- Before, during and after assessment, explore ways to provide students with formal and informal feedback on their methods of thinking in solving problems, as well as the accuracy of their solutions.
- Consider how informal assessment and feedback opportunities can allow students to explore their methods of thinking by giving them the chance to generate multiple and varying ideas/proposals to solving problems, and the chance to critically explore their respective advantages and disadvantages through testing, refinement, and re-application.

Principle theoretical/literature overview

The university context requires students to be largely independent, self-regulated learners, an assumed capability many students are ill-prepared for (Bjork, Dunlosky, & Kornell, 2013; Boud, 2010). Knowing how to evaluate and manage one's own learning is an important capacity central to positive learner outcomes. To be an effective self-regulated learner, a range of explicit skills need to be developed, including executive functioning skills and metacognitive awareness (Bjork, et al., 2013).

Self-regulated learning is an active process in which the learner constructs goals for their learning and then pursues them through deliberate planning, monitoring, regulation and evaluation of their progress, guided by affective processes and contextual features (Pintrich, 2000; Veenman, Van Hout-Wolters, & Afflerbach, 2006; Zimmerman & Moylan, 2009). Effective self-regulation provides individuals with a degree of autonomy to pursue the identified activity or process, taking into consideration individual knowledge and skill level (Goetz, Nett & Hall, 2013). Self-regulated learning involves a personal feedback loop, with the learner engaging with and receiving feedback from social, environmental and personal sources. The ability to self-regulate is developmental, and is an interactional process between self and context: through development, an individual takes on an increased responsibility in their own self-regulation, which is balanced by a decrease in other-regulated processes (Sameroff, 2010). Fundamental to self-regulated learning is the extent to which one thinks about their thinking during the learning process. This process is known as metacognition, and is a very strong predictor of learning (Veenman, et al., 2006).

Metacognition allows effective learners to draw on their knowledge and awareness of thinking processes and regulate their attention in order to modify their thinking whilst engaged in a learning task (Spruce & Bol, 2014; Zimmerman & Moylan, 2009). Metacognitive processes include strategy use and self-monitoring and are an important component of self-regulated learning: the process of self-generating, not just thoughts, but also feelings and actions that support the attainment of ones learning goals (Zimmerman & Moylan, 2009). The metacognition component of understanding learning is referred to as meta-learning: self-awareness about one's own learning and strategy use; of how to apply knowledge; and of one's beliefs, attitudes and behaviours relating to learning (Bostrom & Lassen, 2006; Jackson, 2004). Effective learning therefore requires individual capabilities to attend to both external and internal information and to be able to plan for and make informed choices. The two central processes underpinning self-regulated learning are therefore attention and executive functioning.

Being able to orient and sustain attention – both inwardly and outwardly – is crucial for learning (Posner & Rothbart, 2007). Attention is driven by three inter-related networks: the alerting network, which promotes a state of being ready to learn; the orienting network, the ability to attend through the engagement with sensory signals; and the executive attention network, the conscious control of attention (Posner & Rothbart, 2007). Learner attention can be promoted through the activation of curiosity and interest and the reduction of distractions. Once attention is gained, learners can then draw upon skills of planning, decision making, and goal setting – some of the key executive functioning skills essential for effective learning.

The second process underpinning self-regulated learning is executive functioning. Executive functioning skills are those skills that enable learners to plan, focus, inhibit behaviours, remember instructions, set priorities, problem solve and be cognitively flexible (Huizinga, Dolan & van der Molen, 2006). Executive functioning skills develop from the early years and, like all cognitive processes, are influenced by both biological determinants and environmental experiences across the lifespan, and can be supported and enhanced through explicit learning opportunities. Executive functioning skills can be supported through the opportunity to identify and prioritise goals, engagement in self-reflection, and the facilitation of creative and critical thinking.

Creative thinking has been identified as an essential 21st century employment competency, and is also identified as being of social good (Lucas, Claxton & Spencer, 2013). Creative thinking involves a range of interrelated cognitive and affective skills to explore a problem and find a solution that is both novel and useful within a social context (Plucker, Beghetto & Dow, 2004). Creative thinking is an iterative process that involves the alteration between convergent and divergent thinking: divergent thinking involves thinking outside the box, thinking about things differently or in a contrasting manner – thinking broadly about an idea or concept; whilst convergent thinking involves a sharpened, more focused thinking process (Cropley, 2015). Creative thinking creates excitement, introduces novelty, expands perceptions and awareness, and leads to new ideas, innovation and development across a range of domains (Abraham, 2013). Engaging in creative processes has been found to enhance positive and reduce negative behaviours, and to enhance cognitive function and academic success (Treffinger, Young & Selby, 2002).

Creative and critical thinking work hand-in-hand, supporting learners to explore problems and find solutions. Critical thinking involves the development of a range of dispositions and abilities to enable *"reasonable reflective thinking focused on deciding what to believe or do"* (Ennis, 1989, p.4). It involves the intentional consideration of approaches to problem-solving, drawing on higher-order processes to guide behaviour to solve problems or generate new ideas (Glasser, 1941). Both creative and critical thinking involve a set of skills and competencies that can be taught, fostered and measured within a learning environment (Cropley, 2014; Lucas, et al., 2013; Plucker et al., 2004).

The assumption that learners have already developed strategies around effective learning is common in the university context, and yet the reality is quite different. Effective learning involves making meaning of new knowledge by being an active participant in the process – interpreting, connecting, relating and elaborating in relation to pre-existing knowledge (Bjork, et al., 2013). This requires an awareness of one's thinking, attention, decisions around strategies, problem solving, consideration of alternative solutions, and reflection. Opportunities need to be provided for learners to learn how to learn in the university context. This may involve the explicit instruction of learning, evaluation of existing practices, or the considered design of learning experiences that model these processes.

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“Challenge and difficulty
can be beneficial for
students’ learning process”
The University
Of Queensland

CHAPTER 6

LEARNING CHALLENGE AND DIFFICULTY

Explanation

Challenge and difficulty, which may lead to confusion and failure, can be very important in contributing to a successful learning process and high-quality learning outcomes for students. However, there is a common approach to university teaching that hinges on the assumption that instruction and learning design should minimise student difficulties or failure, as they can be perceived as ineffective for the learning process. This has led some to focus on providing students with extensive learning guidance and scaffolding to minimise challenge/difficulty and/or confusion/failure, and consequently reduce ineffective problem-solving efforts by students.

Optimising the student experience of challenge and difficulty through course instruction and learning design can involve a shift in teaching mindset and more in-depth teaching consideration and experimentation. When university teachers employ the right conditions in instruction and instructional design to challenge students and accommodate their difficulty or failure, students can become adept at dealing with challenges during learning. This can lead to students learning in ways that are more optimal because it results in them encoding/recalling learning more deeply, and also provides them the ability to self-regulate when dealing with more authentic and complex learning problems. Exploring complex problems and allowing flexibility for challenge and difficulty should be encouraged with learners of all levels, including novices, with the appropriate level of guidance and scaffolding.

The type of confusion being discussed is an attribution that can stem from a student's experience of cognitive challenge that is precipitated by a learning impasse. That impasse can relate to any number of cognitive challenges, such as dealing with knowledge gaps, conceptual doubt, conceptual contradictions, dynamic conceptual assumption, and/or procedural uncertainty. Additionally, the type of failure being discussed is the experience of obtaining an inaccurate, erroneous, or incomplete solution/answer. This conception of failure is literal and derived from feedback in the learning environment. It does not relate to existential experiences of failure such as perceptions or attribution related to self-concept (e.g., believing oneself to be a failure), although this can be a distal consequence.

Independently, and/or collectively, these experiences of challenge and difficulty, and possibly confusion and failure, can stimulate beneficial disposition shifts (e.g., curiosity or interest), knowledge expansion (e.g., filling knowledge gaps), and inquiry-driven thinking (e.g., questioning, reasoning, and problem solving). Alternatively, if a student deems these experiences as too much of an impasse, or it persists for too long, it can lead to non-beneficial dispositional shifts (e.g., frustration, anxiety and boredom). Therefore, in designing learning experiences, consideration needs to be given to how challenge and difficulty can operate at an optimal level to enhance the learning process. University teachers can harness this optimal level by appropriately giving consideration to learning objectives, pedagogical parameters, and the instruction and learning design conditions.

The purposeful incorporation of challenge and difficulty, which may lead to confusion or failure in a student learning experience, is neither a generalised solution, nor requirement, for instruction design. Instead, they are elements that can be utilised when aligned to learning objectives. An example could include learning objectives that determine learning content with the complexity to enable deeper understanding and exploration, as

opposed to learning content that is simple or isolated. Furthermore, appropriate pedagogical parameters are needed. This can include students having the space and flexibility to experiment (e.g., sufficient time to explore various approaches to solution), and ensuring that the stakes are appropriate or manageable for students.

To foster the right conditions for challenge and difficulty it can be necessary to initially facilitate students' reconciliation of their prior knowledge with the critical conceptual elements of target problems/topics. After which, without guidance or scaffolding, university teachers can allow students the opportunity to generate and communicate their mental models and representations. This may mean that what they generate or conceive is erroneous, or that they simply become confused. This is where the importance of teacher and peer feedback, in its timing, sequence and/or type, is relevant for the benefits of challenge and difficulty.

University teachers need to engage in a two-way feedback dialogue with students. By doing so, they can determine how much corrective feedback and scaffolding is required to get the right balance, and when it should occur so it is just in time to exploit the optimal learning potential of challenge and difficulty. This also means engaging with students to determine if the concepts or learning problems are too simple or too complex, what students already know and can employ, and their affective state and needs related to confusion and failure.

Furthermore, the feedback that university teachers provide to students should also facilitate students to become adept at dealing with confusion and failure. This might mean students knowing how to recognise when they are confused, their affective thresholds for confusion and failure, and what to do when confused or failing (e.g., how to address gaps in knowledge or resolution strategies to execute). This involves promoting students' capacity to self-regulate their experiences of confusion and failure to enhance their learning process. This process of self- regulation, and relatedly, metacognition, is further explored in the theme *learning to learn and higher order thinking* in chapter 5.

When university teachers address their instruction and learning design to optimise, rather than avoid, challenge and difficulty, considerations towards the socio-cultural factors that surround students' learning experiences can be advantageous. This can mean encouraging opportunities for students to collaborate and explore a diversity of perspectives, which can test and enrich the cognitive mechanisms they employ (e.g., conceptual justification, conceptual critiquing, and conceptual expansion) to resolve challenge, difficulty, confusion, or failure. Additionally, it can mean fostering a course culture where the normative beliefs and attitudes of students and university teachers endorse the utility of challenge, difficulty, and failure for learning. For instance, this may result in a climate where students feel confident to take conceptual positions that are risky and share their justifications, or one in which students see lecturers not primarily as sources of corrective feedback but also sources of inquiry-driven guidance, and similarly for their peers.

Strategies for university teachers

University teachers can explore the role of challenge and difficulty in learning by considering the following strategies when developing their learning and instructional design:

- Ensure learning content and activities have sufficient complexity to allow the learning mechanisms of challenge and difficulty to adequately operate, and that students have sufficient flexibility to experiment and take risks (e.g., time allocation). When determining the degree of complexity, seek to assess students' prior knowledge to gauge what is known and what they can employ in the learning situation when challenged.
- Experiment with, and provide support for, ill-structured learning problems, unpredictability in learning content, or problem-based learning scenarios to facilitate the exploration of challenge and difficulty in student learning.
- Among the many benefits of interleaved practice for enhancing students' learning, it can also provide opportunities for students to exploit the learning potential of challenge and difficulty (e.g., conceptual contradictions and dynamic conceptual assumptions) as they explore different concepts and topics together.
- Facilitate students to become more adept at dealing with, or self-regulating, confusion and failure. This can be achieved by helping students to recognise when they are confused, what their affective thresholds are for confusion and failure, and what strategies and actions can be taken to resolve learning confusion and failure.
- Whilst students can deal with challenge and difficulty in isolation, it can be more advantageous to have them do so in collaborative learning environments. This may contribute to students expanding each other's learning potential from any learning challenge and difficulty experienced. An example could include small group exercises and/or large group discussions where conceptual justifications and conceptual critiquing of solutions, as well as methods taken, are encouraged in a constructive manner to contribute to conceptual expansion.

- Foster a course culture that endorses the utility and exploration of challenge, difficulty, and failure for learning. In this sense challenge, difficulty, and failure are not unspoken and reprehensible experiences, but are instead normalised and valued for their beneficial aspects as a part of the learning process. This might lead students to take risky conceptual justifications and be enthusiastic to share and explore this with their peers. This can also mean paying attention to intercultural sensitivities in students around the connotations attached to the expression, or exploration, of challenge, difficulty, and failure.
- University teachers can share personal stories of conceptual challenge, difficulty, and failure with students. In doing so, university teachers should also try to model appropriate ways they deal with challenge, difficulty, and failure that have optimised the learning process and learning outcomes.
- Becoming confident with optimising the student experience of challenge, difficulty, and failure through course instruction and learning design can be challenging and can involve teacher experimentation. This is where some university teachers might want to engage in explicitly teaching self-reflection, peer observation, and other avenues of professional development.

Strategies for students

Students can explore the role of challenge and difficulty in learning by considering the following strategies during their learning experience:

- Appreciate that being an effective thinker is about an effective method of inquiry to learn and solve problems. This might involve getting the answer wrong or being challenged, but that is a part of an effective method of inquiry, and those experiences merely serve as further information to advance the inquiry method being taken.
- Consider university teachers and peers for their potential as sources of not only corrective feedback, but more importantly inquiry-driven guidance, as this can lead to more discovery on the way to expanding learning. This might mean asking questions about problem reasoning (e.g., asking about assumptions surrounding a theoretical premise to an essay argument, instead of asking for the correct theoretical premise). Therefore, it is about asking the right types of questions to empower learning, even if it takes longer to get to a solution.

Strategies for assessment

Assessment is an important part of the learning experience for students, and university teachers can explore challenge and difficulty in learning by considering the following strategies for assessment:

- Incorporate frequent informal, or low stakes, assessment opportunities for students so that they can experiment with the learning potential of challenge and difficulty. This might mean employing a series of staggered informal, or low stakes, assessment items that culminate to conceptually inform a related larger summative assessment item.
- Engage in dual feedback with students to assess their level of challenge and discern when to provide, or delay, corrective feedback and scaffolding (i.e., so it is just in time), and how much of this feedback is required to maintain optimal challenge and difficulty.
- Explore students' affective states and needs related to challenge, difficulty, confusion, and failure to avoid, or delay, the onset of negative affect (e.g., boredom and frustration). This can mean framing the learning experience to promote positive affect (e.g., interest and curiosity).
- When engaging in feedback dialogues with students, it can be worthwhile explicitly exploring how their methods of inquiry to solve problems relate to their resolution of challenge and difficulty, irrespective of the solution accuracy (i.e., correct or wrong). For instance, this could mean an element of assessment marking criteria relates to conceptual risk taking in problem resolution, and exploring with students how this impacted their methods of inquiry.

Principle theoretical/literature overview

University study exposes students to numerous, complex learning experiences, often creating cognitive challenge. Complex learning experiences feature learning that involves comprehending difficult material, solving difficult problems or making challenging decisions (Lehman, D'Mello, & Graesser, 2012). Overcoming and learning from these challenges involves the complex coordination of internally processed cognitive and affective capacities, along with externally provided support and scaffolding, predominantly from teachers and peers. When an individual is faced with cognitive complexities that challenge their existing knowledge or goals – through contradiction, dissonance, uncertainty, or knowledge gaps – it can result in the subjective experience of confusion (Arguel, Lockyer, Lipp, Lodge, & Kennedy, 2017; D'Mello & Graesser, 2012). Experiencing confusion in the university learning environment can potentially be productive – resulting in deeper understanding – or destructive – resulting in frustration and potential disengagement (Arguel, et al., 2017; D'Mello & Graesser, 2012). The key to managing confusion is resolution, either by the student themselves or by others. However, given the subjective nature of confusion, designing effective complex learning experiences that encourage productive confusion is very challenging.

Confusion is an epistemic affective state as it arises when there are challenges to an individual's existing knowledge and beliefs around learning (Lodge, Kennedy, Lockyer, Arguel & Pachman, 2018; D'Mello & Graesser, 2012; Pekrun, 2006). This creates a cognitive disequilibrium: a subjective state of uncertainty around the knowledge or the desired goals of the learning experience (D'Mello & Graesser, 2012). These may arise as the consequence of knowledge gaps, conceptual doubts, contradictions, assumptions or procedural uncertainty. Cognitive disequilibrium has been found to be a precursor to deep learning when appropriately resolved (Lehman et al., 2012). The experience of confusion in a complex learning scenario results in a shift in disposition: if the confusion sparks curiosity and interest, this can be beneficial, as the learner is then required to engage in effortful problem solving. D'Mello and Graesser (2012) refer to this as productive confusion. However, hopeless confusion in which the learning impasse is unresolved and through which no strategies are provided or accessible, leads to frustration, boredom, potential disengagement from the learning experience, and possible failure (Arguel, et al., 2017; D'Mello & Graesser, 2012).

The timing and intent of these cognitive impasses seem to be crucial. Moreover, presentation of problems that learners cannot yet solve or that may elicit incorrect or suboptimal solutions also have the potential for positive long-term learning. The design of learning experiences that result in this 'productive failure' can result in greater engagement with subsequent instruction to fill the previous knowledge gaps (Kapur, 2016). Productive failure involves designing learning conditions that interrupt short-term learning and success, but can maximise long-term learning (Kapur, 2016). This concept was developed from the earlier work of Schmidt and Bjork's (1992) desirable difficulties: challenging tasks provided to learners in the early phases of learning such as incorporating complexity, providing reduced or delayed feedback, or presenting unguided problem-solving tasks. This approach has been shown to result in a dip in performance initially but to have positive effects on learning outcomes in the long term. In all of these cases, however, resolution is achieved at some point, and this is essential if cognitive disequilibrium is to have a positive effect on learning. This resolution can occur through the timely, relevant, and useful feedback provided by teachers or peers, or the development and activation of appropriate strategies evident in self-regulated learners.

Providing complex learning experiences that allow for collaboration, exploration, investigation, experimentation, creative thinking and problem solving are essential for deep learning. Fundamental to the success of these learning experiences is ensuring the learners have the capacity to integrate the appropriate cognitive and affective processes to enable resolution.

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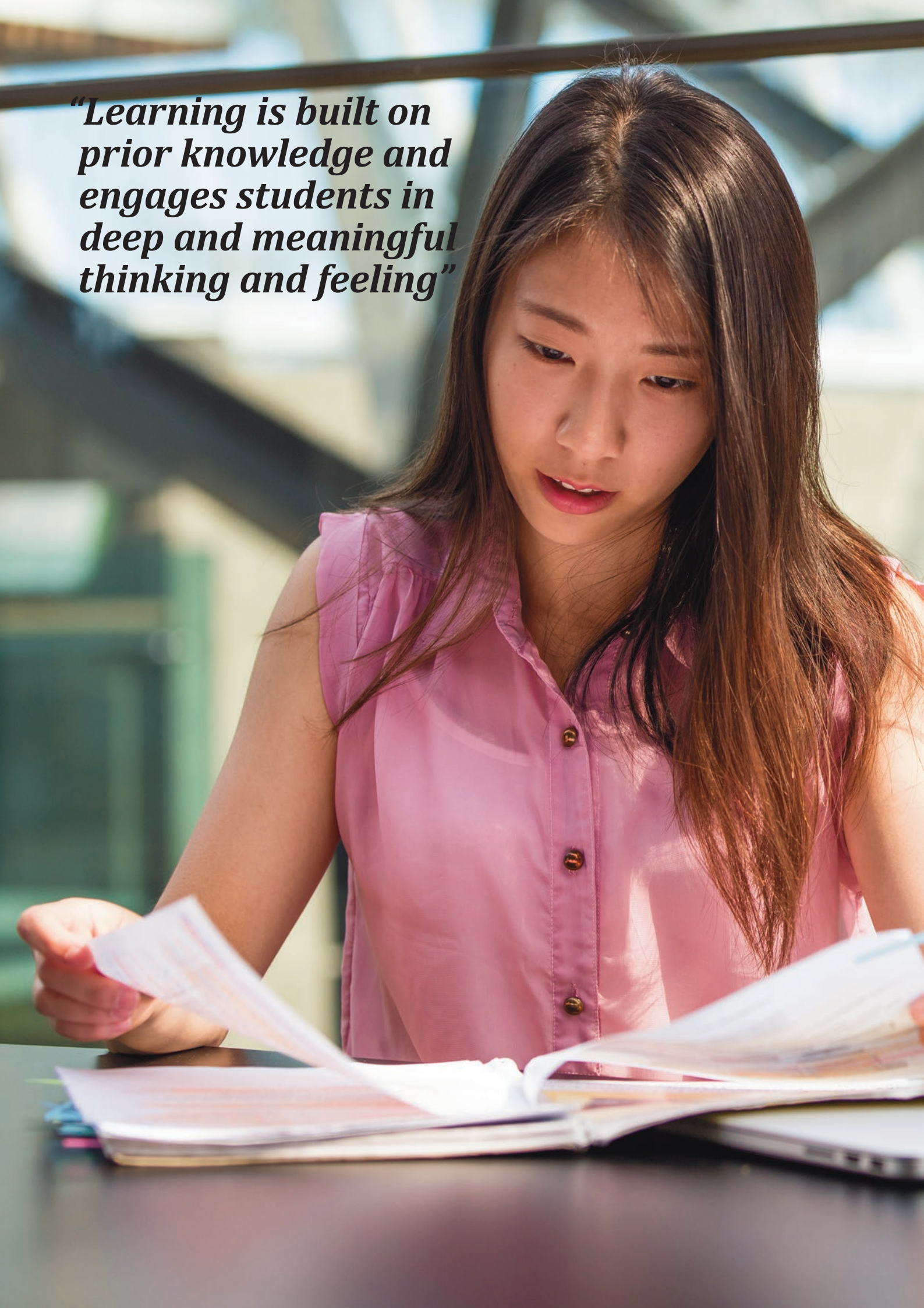
"Learning is built on prior knowledge and engages students in deep and meaningful thinking and feeling"

CHAPTER 7

DEEP AND MEANINGFUL LEARNING

Explanation

This principle is broad in nature and serves as a good indication for what ultimately is an ideal outcome for a student's learning experience. The principle is inclusive of many themes but at its core it represents how to encourage students to engage beyond passive engagement towards a deeper and more meaningful thinking and feeling about the issues at hand. In this sense, many of the lessons from the other principles are reflected in this principle but in a less transparent way, with other prominent concepts explored instead.

Regardless of the instructional approach or technique adopted by a teacher to facilitate student learning (e.g., traditional lecturing or problem-based learning), the focus has traditionally been on the delivery of content, and student engagement largely passive. It is important that students consider the wider impact of what is discussed, and think beyond the box. Such thinking has often been linked with deep and meaningful learning. Accordingly, consideration needs to be given by teachers to encourage students to engage beyond passivity towards deep and meaningful learning.

Engagement with learning content can be encouraged by providing opportunities for students to understand new material by themselves, making connections between their prior knowledge and what they are learning. Building such associations will enable students to find broader meaning in the learning content through activating and connecting with their prior knowledge and experience.

Moreover, it is not just as simple as making conceptual connections. Often, but not always, students need to struggle with the idea or the uncertainty of the concept as they attempt to construct a mental model or representation. This process is often referred to as conceptual change. Changing the way students conceptualise the ideas they are exposed to is powerful for ensuring their long term success. The often difficult foundational concepts of the discipline, referred to as threshold concepts, are the most important for students to acquire and understand. Helping students to integrate these concepts with their prior knowledge is challenging but vital. Once a mental model, or representation is formed, the challenge is to transfer that knowledge to novel situations and problems. This transfer process is one of the key factors determining how prepared they will be to become professionals, scientists or scholars after they graduate. It should be noted, this process of deep and meaningful learning can be situated in some degree of novelty from the onset of teaching.

To implement this approach, the university teacher needs to be able to gauge students' prior knowledge, and the level of challenge that students experience, by interacting with them and assessing students as they engage in this deep and meaningful learning process – clearly educational technologies can also aid this process. The implementation of these approaches and technologies requires experimentation and reflection by the university teacher to find the right balance.

Accordingly, when university teachers facilitate students' agency to engage in deep and meaningful learning, the focus is as much on knowledge acquisition and solutions to problem solving tasks, as it is on the learning process taken by students. By doing so, university teachers can also engender the development of cognitive/critical thinking, metacognitive and self-regulation capabilities in students.

Strategies for university teachers

University teachers can foster students to build upon their prior knowledge and engage in deep and meaningful thinking by considering the following strategies when developing their instructional design:

- Explore ways of providing meaning and contextualisation around student learning activities to help students connect current learning to prior experiences to garner deeper engagement with what they are learning and why they are learning it. In doing so, continually give and seek feedback from students so that informed pedagogical judgements can be made.
- Experiment with ways to challenge students to think broadly about concepts and ideas to transition from surface to deep level thinking, where conceptual change (e.g. threshold concepts) is more feasible. However, appreciate that when challenging students there needs to be adequate support.
- Encourage students to accept that struggle, and perhaps even setbacks, when they are learning can be a means of achieving conceptual change and insight, where doing so can lead to deeper understanding that translates to better achievement. Explore with students ways that they can deal with and respond to their learning challenges and setbacks in a productive manner, and provide support to students in so doing.
- Seek ways to encourage students to vocalise and share their learning (e.g. through opportunities for formative feedback or group work), as the more interactive students are about their learning, the more scope there is for students to garner opportunities to engage in the mechanisms that promote deep and meaningful thinking.

Strategies for students

Students can build upon their prior knowledge and engage in deep and meaningful thinking by considering the following strategies during their learning experience:

- When approaching learning try to relate current learning to prior experiences for deeper learning – making connections between what is known and questions that remain unanswered.
- Intentionally find meaning and relevance with newly learned information so that it extends upon real-world experiences, and deliberately seek challenge or at least do not shy away from it when approaching learning material.
- Seek to develop skills to vocalise and share acquired understanding and learning, even when it is difficult, challenging or confusing.
- Seek to develop skills in monitoring progress and knowing what to do when struggling to find solutions.
- Understand that difficulty/struggle/confusion can be critical for deep and meaningful learning, particularly when attempting to understand difficult or complex concepts.

Strategies for assessment

Assessment is an important part of the learning experience for students, and university teachers can utilise assessment to help students to build upon their prior knowledge and engage in deep and meaningful thinking by considering the following strategies for assessment:

- Opportunities to increase the authenticity of assessment (e.g., reflect real challenges in the workplace) should be explored to promote student engagement and transfer of learning beyond university. By doing so, more authentic assessment also allows students to connect their learning with past and future experiences in the transfer of their knowledge.
- Assessment tasks should be clear in purpose as to how they achieve learning objectives, and task descriptions should be explicit and clear enough to ensure that students are not wasting cognitive resources on understanding task parameters.
- Assessment should provide opportunities for students to build on prior knowledge rather than just complete the production of an isolated artefact. In doing so, tasks should involve problem solving activities that go beyond content knowledge and challenge students to explore their processes and methods to engage in deeper thinking and problem resolution.

Principle theoretical/literature overview

Deep and meaningful learning has been long viewed as critical for student development in higher education. For several decades, deep learning has been contrasted with shallow or surface learning and strategic learning (e.g. Biggs, 1978; Entwistle & Ramsden, 1983; Marton & Säljö, 1976; Prosser & Trigwell, 1999). The notions of deep and surface learning broadly align with research on information processing such as the fast and slow processing systems described by Kahneman (2011).

Despite the intuitive usefulness of the deep and surface distinction, this dichotomy has been criticised for oversimplifying the complexities of student learning in higher education (Haggis, 2003; Lodge & Bosanquet, 2014). Deep and meaningful learning builds on students' prior knowledge and connects with their future careers and opportunities for lifelong learning for both near and far transfer (Barnett & Ceci, 2002; Jackson, 2016). At a psychological level, this involves the acquisition and updating of complex conceptual ideas, rearrangement of mental schema and the overcoming of intuitive misconceptions (Ohlsson, 2011). However, this is not to suggest that surface and deep learning are not interrelated, in fact they can be mutually dependent, and surface learning can be required to reap the benefits of deep learning (Hattie & Donoghue, 2016).

The process of conceptual change is an important example of how deep and meaningful learning can be examined, and therein its complexity as a principle. To understand and apply complex artefacts within students' disciplines often requires students to employ deeper thinking to engage in a form of conceptual change (e.g., Meyer & Land, 2005). This profound conceptual change can be unintentional, intentional, or a mixture of both. In cases of unintentional conceptual change students undergo a thinking process that is often bottom-up, conservative, additive and involves largely unconscious mechanisms (Duit & Treagust, 2003; Vosniadou, 2007). Some examples of this can include naïve/uncritiqued learning of static explicit knowledge like letters in the alphabet. On the other hand, intentional conceptual change can involve thinking processes that are top-down, radical, deliberate and require slow thinking and concerted learning efforts by students (Duit & Treagust, 2003; Kahneman, 2011, Vosniadou, 2007). Some examples of this can include engaging in the scientific method of falsification, hypothesis testing, assumption testing, critique sourcing, deconstructing and reconstructing concepts to transform knowledge.

A mixture of both intentional and unintentional conceptual change can involve the interchange between conscious/deliberate and unconscious/non-deliberate thinking processes around a concept to achieve conceptual change (Duit & Treagust, 2003; Vosniadou, 2007). Some examples of this can include working on a learning problem, subsequently engaging in an unrelated activity but unconsciously resolving the learning problem, and then returning to the learning problem with an enhanced conceptual depth to solve the learning problem. This process of interchanging between intentional and unintentional conceptual change can be related to what some have described as insight learning or 'Ah ha' moments (Kounios & Beeman, 2009). Across these different methods for conceptual change implications can be drawn for the ways students are taught. This can include ensuring that teaching time is accurately focused on exploiting intentional conceptual change for students through university teachers employing an instructional and learning design that accommodates for learning mechanisms of intentional conceptual change.

Deep and shallow approaches to learning provide a solid foundation for better understanding the levels at which students engage in processing the content they are exposed to during their studies. Research conducted in the science of learning over the last decade is generating a fuller picture about how deep processing and sophisticated conceptual understanding occurs in the brain and mind. This research provides a basis for teaching practices that facilitate deeper conceptual understanding and for providing meaningful learning experiences that translate beyond the classroom.

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Appendix

Higher Education Learning Framework

Overarching Theme & Principle

		Implications for teachers	Implications for students	Implications for assessment
Learning as becoming	A university education provides a learning experience that broadens students' knowing and being for life beyond the classroom	• Consider students' future career paths and their time at university as an integrated experience; predicating your teaching towards them and their learning experiences not as finite 'students' but as 'evolving professionals'. • Explore with students how undertaking a course or degree program can influence their self-identity, and encourage students to be open to exploring how it impacts upon their perceptions, beliefs, social interactions, and behaviours, inside and outside of the classroom. • Discuss with students how the broader contexts of community and society influence a student, and how they in turn can influence community and society. Explore with students both the epistemology of knowledge, and how it is students' responsibility to examine and question that knowledge. • Encourage students to adopt a mindset of education as a lifelong pursuit.	• Avoid relying on lecturers as an absolute source of knowledge, but rather appreciate lecturers as facilitators of knowledge. In doing so, take the responsibility to critically examine the discipline knowledge offered by lecturers and develop your own epistemology around that discipline knowledge. • Engage in formal or informal self-reflection to explore how the broader contexts of community and society influence what you have been learning, and how you can influence community and society through your learning. • Reflect upon how your learning influences your self-identity, and be open to exploring how that influences your beliefs, perceptions, social interactions, and behaviours, inside and outside of the classroom.	• Include a variety of self-reflective assessments, so that students have time designed into the course to examine and self-reflect on their learning from an ontological perspective. • A distal outcome of assessment should be that students are able to attest and explain what their knowledge and skills means to the world and their discipline. This is a step beyond simply explaining what specified bodies of disciplinary knowledge and skills they have acquired, but what that knowledge and skills means for their ability to impact and influence society at large, and how they can address problems outside of their discipline with their disciplinary knowledge and skills.
Contextual learning	Learning occurs in context, and context can be used to enhance the learning experience	• Utilise contextualised teaching approaches and techniques (e.g., case-based learning, project-based learning, simulated learning, professional guest speakers, etc.), or work- integrated learning experiences (e.g., practicums and internships) to provide opportunities for students to contextualise their learning to reflect disciplinary or professional practice. • Integrate real-word problems as a vehicle to teach students about learning content as it is situated in the discipline, and concurrently examine with students the analytical methods and techniques that occur in disciplinary/professional practice. • Facilitate student thinking about course content across multiple contexts, including those in a student's real life (e.g., casual job, local community, weekly sporting team, or home life). Noting that good quality learning can take place inside and outside of the classroom, even when transferred to unrelated or novel contexts. • Recognise a student's own ability in self-directing their learning towards a contexualised learning experience, and work together to co-create that learning experience. • Regularly consult and engage with relevant stakeholders across industry (e.g., government and representative professionals), community (e.g., NGOs) and alumni (e.g., graduates working in discipline) to examine how courses can remain 'current' in how they contextually reflect practice. Also, utilise these relationships to draw upon opportunities for industry to engage with courses and students.	• Consider how course content can transfer contextually to other avenues of application, as well as to your chosen career path. This includes in your real world outside of academic contexts - casual job, local community, weekly sporting team, or home life. • Seek out a variety of work-integrated learning experiences (e.g., practicums, internships, volunteer projects, etc.), both through university and outside of university. • Attend industry events (e.g. networking meetings, public seminars, and conferences) to transfer/test your knowledge in informal work-related contexts, and immerse yourself in the culture and practices of that discipline. • Explore the bi-directional relationship between academic and external contexts. For example, how professional practice can influence course learning content, and how course learning content can influence professional practice. • When studying for exams explore the learning content in different contexts (e.g., try to imagine or simulate yourself applying the revision content in workplace scenarios or relevant novel contexts).	• Explore ways assessment can be contextualised so that it reflects more authentic and real-world contexts (e.g., workplace scenarios). This can occur at any level of assessment. For instance, multiple choice questions have the potential for being contextualised in a similar way to essay questions. • When considering the type of assessment items to employ in a course, consult with industry to understand the type of tasks/challenges professionals in that discipline experience, these can be emulated into student assessment items. For instance, in some courses a briefing letter may more authentically contextualise a written assessment item than an argumentative essay. • Utilising informal assessment in courses can be very effective for student learning. This is even more the case when that informal assessment requires students to test their knowledge across different and novel contexts/scenarios. • Consider continuity between students experiencing both contextualised learning and assessment together. This means that authentic and contextualised assessment leads on from authentic and contextualised teaching.
Emotions and learning	Emotions play a role in how and why students learn	• Promote a learning environment that engenders a sense of belonging and relatedness, and foster a positive and enjoyable learning culture. • Build quality relationships with students focusing on the meaning derived from students' engagement with a lecturer, not just upon the quantity of time spent with a lecturer. • Help to assure students' perceived 'effort to reward' relationships by making transparent the course design, and addressing arbitrary or bureaucratic elements that can undermine the fidelity of these relationships. • Encourage students to develop their self-efficacy by having them set and explore mastery-related goals. Also engage in dialogues with them that reflect the malleable nature of their abilities and their capacity to improve. • Foster students' perceptions of their autonomy and agency by providing them with flexibility and choice. Explore with students how they can regulate their emotions when learning.	• Review the nature of the goals you set yourself around your learning, and seek to explore what value mastery-related goals can offer you as compared to only performance-orientated goals. • Self-reflect and examine how you think about the malleability of your abilities, and seek to explore strategies for emotional self-regulation and resilience. • Actively engage with fellow students and other social agents in your learning environment both within, and outside the classroom. By doing so, also seek to discover how you can relate with your peers through being open to shared experience. • Foster your interest and curiosity in learning by intentionally finding relevance and meaning in learning content.	• Explore how a course approach can focus upon a paradigm of explicitly communicating high expectations about students' ability to perform, offers opportunities for low stakes and regular assessment, and provides opportunities for high support though frequent developmental feedback. • Offer feedback dialogues that are specific, timely, developmental, and outline how to improve. Avoid giving feedback that is deterministic or offers absolute judgment. • Seek to balance the provision of awards for a course that are not just related to high academic achievement – for example include an award that focuses upon impact or innovation achievement, or alternatively have awards situated within external contexts of the community and industry that emphasise professional character attributes.
Interactive learning	The social dynamics of learning can be leveraged to enhance the learning experience	• Promote social interactivity with diverse peers as part of the learning experience. At a simple level, this can mean incorporating peer-assisted learning activities into lectures and/or tutorials. At a more extensive level, this can mean having students engage in interdisciplinary courses, or projects, that involve a variety of students from different degrees learning together. • Facilitate a culture among students that fosters shared values and beliefs, and is perceived as a safe and inclusive environment for students to exchange a diversity of perspectives. • Appreciate that effective collaboration on learning tasks can take time, with successful collaboration requiring students to develop a level of social synchrony with each other. Promote students' capabilities to socially interact in an effective manner by exploring ways to develop their written and verbal communication skills. • It is important that any strategies to promote the social dynamics of learning should avoid the arbitrary addition of social elements (e.g., group tasks) unless it clearly aligns with the learning content and objectives.	• Self-reflect upon how social interactions enrich the diversity of perspectives you are exposed to, and what this means for your learning and thinking in terms of expanding your conceptual knowledge, ways of thinking, and cooperative skills. • Explore opportunities to enrich the social dynamics of your learning by engaging in socially diverse learning experiences that are available to you. For example, taking elective courses in other disciplines to engage with students outside of your discipline, or enrolling in international exchange opportunities with external universities. • Appreciate that effective collaboration and cooperative learning on tasks can take time, and it is often not immediate. Exercise patience and be open minded towards interactive learning tasks as a learning opportunity. • Self-reflect upon how you can enhance the social dynamics of exchanging perspectives with others through your communication and social skills.	• Where appropriate, incorporate a variety of socially interactive learning assessments in a course (e.g., group assignments and/or peer marking) that align with the learning content and objectives. • In socially interactive learning assessments, include a self-reflective element that requires students to examine the social dynamics of the assessment, and the impacts upon their learning and thinking.
Learning to learn and higher order thinking	When students employ effective methods of thinking, and understand how they learn, they can improve the way they learn	• Assist students in their methods of thinking with respect to the analysis and synthesis of learning content and problems, as well as providing guidance to reach answers. This can relate to how students deconstruct, explore, appraise, and reconstruct problems in both accurate/expected and inaccurate/non-expected ways. • Support students to gain greater metacognitive awareness about their learning, and relatedly, to exercise greater metacognitive regulatory actions. This in turn will promote students' ability to self-regulate their learning. • Strategically use the repertoire of labels related to higher order thinking skills when teaching and assessing students, and moreover, explicitly teach students what they mean (e.g., explaining, justifying, analysing, synthesising, applying, and/or evaluating; what are their respective methods and how do they converge and diverge). • Aid students to be able to make evaluative judgments about their own capabilities or performance at any stage of learning (pre/post formal assessment). • Explore how student opportunities for self-directed learning can be integrated with socially interactive learning or practice, and when and how they best complement each other, giving students the opportunity to make visible their learning.	• Appreciate that being an effective thinker is about effective methods of thinking to learn and solve problems. This might involve not only reflecting upon the strengths and weaknesses of the solution to a problem, but also upon the strengths and weaknesses of the thinking processes/strategies used and their relative effectiveness. • Challenge your thinking about the content you learn about in multiple dimensions by questioning assumptions, prevailing beliefs, and methods. • Seek to make evaluative judgments about your own capabilities/performance at any stage of learning (pre/post formal assessment). This means developing your ability to make evaluative judgements in a rigorous way by producing learning criteria that are precisely defined and coherently applied. • Take responsibility to critically examine the discipline knowledge offered by lecturers and peers, and develop your own epistemology around that discipline knowledge. • Approach your learning as if you were to not only be tested on it, but also had to teach it. In doing so, examine how your learning relates or contrasts to other known/unknown contexts and application pathways. • When revising lecture content explore and experiment with a range of studying strategies to see what works best for you. For instance, try practice testing, elaborative interrogation, and self- explanation, as these can be more effective than other approaches such as summarisation and serial re- exposure to learning content (e.g. re-reading/re-watching).	• When designing assessments or introducing assessments to students, it is important to actively involve students in the creation or comprehension of the assessment criteria, as well as the application of the assessment criteria. In this way, it helps students identify, make sense of, and own the criteria that they need to apply to their own learning tasks or work, as well as their capability to make more robust evaluative judgments. • When exploring assessment criteria with students, make sure to provide specific descriptions and exemplars that demonstrate the relevant aspects of the assessment criteria. In this way, it helps students to comprehend the standards associated with assessment criteria. • Before, during and after assessment, explore ways to provide students with formal and informal feedback on their methods of thinking in solving problems, as well as the accuracy of their solutions. • Consider how informal assessment and feedback opportunities can allow students to explore their methods of thinking by giving them the chance to generate multiple and varying ideas/proposals to solving problems, and the chance to critically explore their respective advantages and disadvantages through testing, refinement, and re-application.
Learning challenge and difficulty	Challenge and difficulty can be beneficial for students' learning process	• Ensure learning content and activities have sufficient complexity to allow the learning mechanisms of challenge/difficulty to adequately operate, and that students have sufficient 'learning room' to experiment and take risks/fail (e.g., time allocation). • Experiment with, and provide support for, ill-structured learning problems, unpredictability in learning content, and problem-based learning scenarios to facilitate the exploration of challenge and difficulty in student learning. • Consider the use of interleaved practice for enhancing the learning potential of challenge and difficulty (e.g., conceptual contradictions and dynamic conceptual assumptions) as they explore different concepts and topics. • Facilitate students to become more adept at dealing with, or self-regulating, the confusion and failure that can occur when experiencing learning challenges and difficulties. This can be achieved by helping students to recognise when they are confused, what their affective thresholds are for confusion and failure, and what strategies and actions can be taken to resolve confusion and failure. • Foster a learner culture that endorses the utility and exploration of challenge/difficulty for learning, and non-stigmatisation of confusion and failure. • Lecturers can share personal stories of experiencing learning challenges and difficulties, or even learning confusion and failure with students. In doing so, they should also try to model appropriate ways they have dealt with these experiences to optimise the learning process and learning outcomes.	• Appreciate that being an effective thinker might involve dealing with learning challenges and difficulty, and even getting answers wrong or being confused, but that can be a part of an effective learning process, and those experiences merely serve as further information to advance the inquiry method being taken. • Consider lecturers for their potential as sources of not only corrective feedback, but more importantly inquiry-driven guidance, as this can lead to more discovery on the way to expanding your learning. This might mean asking questions about your problem reasoning (e.g., asking about assumptions surrounding a theoretical premise to an essay argument, instead of asking for the 'correct' theoretical premise). Therefore, it's about asking the right types of questions to empower your learning, even if it takes longer to get to a solution.	• Incorporate frequent informal, or low stakes, assessment opportunities for students so that they can experiment with the learning potential of challenge and difficulty, and take risks to fail or be confused. This might mean employing a series of staggered informal, or low stakes, assessment items that culminate to conceptually inform a related larger formal assessment item. • Engage in dual feedback with students to assess their level of challenge/difficulty/confusion and discern when to provide, or delay, corrective feedback and scaffolding (i.e., so it is 'just in time'), and how much of this feedback is required to maintain optimal learning. • Explore students' affective states and needs related to challenge and difficulty to identify the onset of negative affect (e.g., frustration). This can mean framing the learning experience to promote positive affect (e.g., curiosity). • When engaging in feedback dialogues with students, it can be worthwhile exploring the reasoning to their solutions, irrespective of the solution accuracy (i.e., correct or wrong).
Deep and meaningful learning	Learning is built on prior knowledge and engages students in deep and meaningful thinking and feeling	• Provide meaning and context to help students connect current learning to prior experiences, acknowledging diversity of prior experience. Challenge students to think deeply about concepts and ideas, and offer the appropriate level of difficulty. • Encourage students to challenge the content they learn about in multiple dimensions, this means encouraging students to critically question and challenge assumptions, prevailing beliefs, and methods. • Encourage students to generate multiple and varying ideas and proposals to solving problems, and then critically explore their respective advantages and disadvantages to test, refine, and re-apply. • Ensure learning content and activities have sufficient complexity and that students have sufficient 'learning room' to experiment, take risks, collaborate, and self-reflect. Appraise that students have sufficient prior knowledge to engage in the kinds of learning activities and outcomes expected. • Provide certainty around the learning experience, ensuring task clarity, reducing irrelevant learning content, and non-pedagogically focussed instructional distractions.	• Appreciate lecturers as facilitators of knowledge, and not as an absolute source of knowledge. Relate current learning to prior experiences. • Intentionally find meaning and relevance to learning content. • Use effective strategies to help connect new understandings to prior knowledge. • Deliberately seek challenge to explore the complexity of concepts and the relationship between concepts, or at least don't shy away from it.	• Seek to include assessment that provides opportunities for students to build on prior knowledge and involves problem solving activities that go beyond content knowledge. • Consider how frequent formal and informal assessment with continual feedback can be incorporated into a program, and emphasise to students the purpose of providing feedback.

CONTRIBUTORS

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Annita Nugent has been associated with the Science of Learning Research Centre at The University of Queensland since its inception, initially as the Chief Operating Officer, and more recently as Manager, Research Translation. A qualified patent attorney, Annita has over 25 years-experience in the translation and commercialisation of research findings. Prior to joining the SLRC Annita was Manager, Innovation and Commercial Development for the Queensland Brain Institute. Her research focus is on science policy, specifically its influence on university-industry collaboration and the efficient translation of research findings into actionable outcomes. Presenting an opportunity for research findings from the SLRC to influence learning in the higher education sector, Annita is committed to the development of a framework that can be operationalised by university teachers and institutions alike.

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Associate Professor Jason Lodge has expertise in psychological science, the learning sciences and higher education. A member of the Science of Learning Research Centre, his research focuses on the cognitive and emotional factors that influence student learning and the student experience in educational settings. He is predominantly interested in the ways changing communication channels introduced through technological innovations are influencing the development of metacognition, critical thinking, expertise and professional ways of being. Psychological factors he investigates include information processing, selective attention, fluency, motivation, emotion and memory. A/Prof Lodge also has specialist knowledge and experience in student attrition, educational technology, learning analytics, curriculum and educational design, assessment and evaluation.

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Professor Carroll is a Chief Investigator and Coordinator of Translational Outcomes within the Science of Learning Research Centre at The University of Queensland where her research is particularly focussed on understanding the impact of emotions, attention, and behaviour on learning throughout child and adolescent development, and to develop and implement strategies that can be translated into educational outcomes. Professor Carroll and her research team are collecting empirical, physiological data and developing new technologies to investigate topics including: real-time emotional states of students; regulating emotions through intervention approaches; identifying neural markers of attention readiness; and teaching foundation skills of attention control in young children. In addition to better understanding the process of learning, it is hoped that these new technologies will provide translational outcomes for classroom practice and for training the next generation of teachers.

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Rupert Bagraith is a Project Officer in the Science of Learning Research Centre at The University of Queensland. A registered Psychologist with postgraduate training in Organisational Psychology, Rupert has been involved in the development, implementation, and evaluation of a number of initiatives within the private, government, and education sectors. His research, teaching, and consulting experience has focused on organisational and capability development, as well as more specifically on professional and student learning.

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Professor Pankaj Sah is Director of the Science of Learning Research Centre and Director of the Queensland Brain Institute at The University of Queensland. He is renowned for his work in understanding the neural circuitry of the amygdala, an area of the brain that plays a central role in learning and memory formation. His laboratory uses a combination of molecular tools, electrophysiology, anatomical reconstruction, calcium imaging and behavioural studies to examine the electrophysiological signatures of different brain regions and their impact on learning. He is also the Editor-in-Chief of the Nature Partner Journal *npj Science of Learning*, a journal that brings together the findings of neuroscientists, psychologists, and education researchers to understand how the brain learns.

Acknowledgements

We wish to acknowledge our colleagues in the SLRC who provided advice in the design of this project:

- Professor Merrilyn Goos – School of Education, The University of Queensland (Professor of Education, University of Limerick as of September 2017)
- Professor John Hattie – Melbourne Graduate School of Education, The University of Melbourne
- Professor Gregor Kennedy – Melbourne Centre for the Study of Higher Education, The University of Melbourne.

Thank you to the many people who generously gave of their time to participate in this study, during both the interview and consultation stage.

We express a special gratitude to Professor Doune Macdonald, Pro-Vice-Chancellor (Teaching and Learning) at The University of Queensland for her unrelenting support of this project.

We thank Dr Nick Valmas – Queensland Brain Institue, The University of Queensland for design of this report.

This project was made possible with the support of the Australian Research Council – Special Research Initiative: Science of Learning Research Centre, The University of Queensland and The University of Melbourne.

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