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Design thinking-learning and lifelong learning for employability in the 21st century

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Abstract

Surviving and thriving in this 21st century volatile, uncertain, complex, and ambiguous (VUCA) world caused by rapid digitalisation and changing work landscape, requires agile organisations with agile employees who are adaptable, resilient, and actively engaged in lifelong learning. A blended workforce encompassing full-time and 'gig' employees, working in tandem with smart machines, calls for an innovative and collaborative workforce capable of critical thinking and creative problem solving. This paper aims to highlight the potential of design thinking approaches to foster lifelong learning and graduate employability in a VUCA environment. The paper outlines an empirical study investigating the multiple benefits of incorporating design thinking process attributes in higher education. It argues that such processes can result in the development of 21st century skills and mindset and graduate capability themes that promote lifelong learning skills. Incorporating such strategies offers the potential to narrow the competency gap between workforce and work and enhance the employability and career development of graduates. The paper offers a Framework for Lifelong Learning in a VUCA environment that outlines the powerful traits that arise as payoffs from engaging in and practising design thinking. This framework can serve as a preliminary guide for higher education educators, learning organisations and individuals to inculcate and enhance lifelong learning.

Keywords
VUCA, design thinking, higher education, lifelong learning, graduate employability, graduate capability themes, framework for lifelong learning

Introduction

As compared to a decade ago, graduate unemployment and underemployment are on the rise (International Labour Organization, 2020; The Foundation for Young Australians, 2020). At the other end of the spectrum, employers are having difficulty finding suitable candidates to fill vacancies (Hutchens, 2021; Manpower Group, 2018). Higher education has arguably not kept pace with the rapidly evolving digitalisation (LeBlanc, 2018; Orr et al., 2020). Consequently, there exists a disconnect between preparing the workforce and work (The Foundation for Young Australians, 2018; Zaber et al., 2019). Further, the rapidly changing digital landscape means that 21st century employees can expect to change jobs and continue learning throughout their employment (Richards & Dede, 2020; The Foundation for Young Australians, 2020).

Higher education institutions are increasingly challenged to prepare graduates not only for a better employment opportunity but also to remain employable in a dynamic 21st century volatile, uncertain, complex and ambiguous (VUCA) environment. This preparation often takes place through opportunities to develop employability capabilities, where employability is defined as 'institutionally driven activities and individual capabilities that culminate in heightened probability of being employed and self-managing future career trajectories' (Cook et al., 2021). To remain employable, graduates need to be equipped with lifelong learning skills and ability to self-manage their career development (McKenzie et al., 2021), where lifelong learning is defined as learning across the life span in formal settings of schools, colleges, universities and adult educational institutions as well as informal learning at home, at work and the wider community and anything in between or non-formal learning (Organisation for Economic Cooperation and Development, 2001).

Graduate employment and employability in a VUCA world

In the last decade, the 21st century VUCA environment has progressively driven organisations to adopt a lean strategy, diminishing the full-time secure employment landscape while encouraging a rise in flexible 'gig' jobs and platform economy supporting self-employment and entrepreneurship (Vallas & Schor, 2020). Rapid digitalisation and an eventual balance between task redundancies due to automation and creation of new tasks is predicted (Acemoglu & Restrepo, 2018) leading to the advent of a blended workforce of machines and human to optimize work (Nardo et. al., 2020). In such a setting, human capabilities that are superior to machines such as creativity, personal empowerment, empathy and ability to reflect in conditions of complexity and uncertainty would be in demand (Bass, 2018). This argument supports the findings of a study that examined over 250,000 online job advertisements for post college applicants to establish four 21st century skill sets prioritised by employers: oral communication, written communication, collaboration, and problem solving (Rios et al., 2020).

To survive competition in an uncertain marketplace, organisations have to remain lean and agile, relying on emerging technologies to ensure efficiencies and effectiveness. This has led to machines replacing manual labour and impacting the nature of employment - reducing the number of workers required to do the same amount of work, changing skill sets and requiring a workforce that is more knowledge intensive and capable of higher order thinking (Nardo et al., 2020; World Economic Forum, 2022). Learning agility or the ability of organizations and individuals to learn, unlearn and relearn quickly to keep up and stay ahead is key to survival (Bundtzen & Hinrichs, 2021). An approach that may offer individuals and organisations strategies to build these capacities is design thinking.

Design thinking in a VUCA environment

As a constructivist, multidisciplinary, collaborative, and creative problem-solving approach, design thinking is viewed by some to have potential to equipping future employees with both the discipline knowledge and skills as well as 21st century transferable skills (Pande & Bharathi, 2020; Panke, 2019; Wright & Wrigley, 2019). The design thinking process as introduced by David Kelley at the Hasso Plattner Institute of Design at Stanford University, commonly referred to as the ‘d.school’, comprise 5 non-linear and reiterative modes i.e., empathy, problem definition, ideation, prototyping and testing. In the design thinking approach, empathy for the user encourages reflective framing and reframing of complex problems leading to multiple alternative and extraordinary solution considerations. The resulting creative and innovative ideas are then prototyped and user-tested for incremental reiteration and recreation of solutions that best fit the user. Therefore, reiteration is an essential aspect of prototyping and testing while collaboration and reflection are encouraged across the modes. Practising these actions assist to meet the requirements of rapidly changing consumer demands in a VUCA environment (Cousins, 2018). Indeed, the repeated incremental reiterations can potentially encourage employees to acquire self-efficacy and mastery, embrace challenges, take risk without fear

of failure, and persevere with effort to overcome adversity (Jobst et al., 2012; The Stanford d.school, n.d.).

The multidisciplinary collaborative approach in design thinking lends to diverse perspectives leading to multiple creative solutions (Reiter-Palmon & Leone, 2019) and innovations (Von Thienen et al., 2017). Organisations that adopted design thinking practices have been shown to deliver a 10-year return of greater than 200% of the US stock market three years in a row (Rae, 2016). Design thinking strategies have been found to lead to enhanced innovation outcomes through producing higher quality solutions, reducing risk and cost of failure, improving likelihood of implementation, improving organisational adaptability and creating local capability sets (Liedtka, 2018). The real-life complex problems that drive the design thinking process has potential to trigger curiosity (Jordan et al., 2014), an important disposition for exploration of knowledge or learning (Wade & Kidd, 2019) and lifelong learning (Fulcher, 2008). Curiosity in turn could foster organisational agility, learning culture and operational effectiveness (Horstmeyer, 2019), the very capabilities demanded by a VUCA environment.

Incorporation of design thinking in higher education curriculum has the potential to not only enhance immediate learning but also better prepare graduates for future work and career development in a VUCA environment. The disciplines of design, architecture, business, and engineering have experimented with design thinking, resulting in beneficial acquisitions of knowledge, skills, and mindsets (Coorey & Caldwell Rinnert, 2019; McLaughlin et al., 2022; Panke, 2019; Wright & Wrigley, 2019). As an authentic, creative problem solving, collaborative and reflective learning process, design thinking has potential to fulfil both the epistemology and ontology of learning (Tschepe, 2018), instil transferable skills while encouraging deep rather than surface learning through the contextualization of learning to real-life problems, driving learning and knowledge construction through learning by doing. For example, a set of instructional elements for mARC (more Authentic, Reflective and Collaborative learning) has been shown to benefit the process of de-contextualization and re-contextualization in experiential learning (Radovic et al., 2021).

However, higher education has been slow to adopt the design thinking approach at a wider institutional level. This is in part because application of design thinking in diverse disciplines has been under researched and lacks empirical evidence to support further adoption (McLaughlin et al., 2022; Melles, 2020; Wright & Wrigley, 2019). Another hurdle is the difficulty to implement an ideal design thinking process. For example, practitioners need to possess a beginner's mindset (be open minded, non-judgemental and risk-averse), empathy is often biased by individual's perceptions and experiences, prototyping and reiteration demands visual thinking and time and collaboration in diverse multidisciplinary teams is challenging (Carlgren et al., 2016; Panke, 2019).

Nevertheless, the essence of design thinking - human centredness - has the potential to incite intrinsic motivation (Pavey et al., 2012), where intrinsic motivation is defined as the 'inherent tendency to seek out novelty and challenges, to extent and exercise one's capacities, to explore and to learn' (Ryan & Deci, 2000). Taken further, intrinsic motivation could possibly inculcate characteristics of lifelong learning such as a growth mindset or belief that capability can be developed throughout life, curiosity, grit, mastery and self-efficacy, (Bollington, 2015; Dweck, 2017).

Considered all together, the features outlined above suggest that the design thinking approach offers the opportunity for higher education learners to inculcate lifelong learning characteristics required for thriving in the 21st century VUCA environment. The alignment of these characteristics is further explored in Table 1, which maps the characteristics of lifelong learning synthesised by Bollington (2015) and established by others (see Candy et al., 1994; Lawson et al., 2006; Mwaikokesya et al., 2014) with the process attributes of design thinking (The Stanford d.school, n.d.; Tschepe, 2018).

Table 1: Alignment of Design Thinking Process Attributes with Characteristics of Lifelong Learning

<table>
<tr><th>Process Attributes of Design Thinking
(adapted from: The Stanford d.school, n.d.; Tschepe, 2018)</th><th>Characteristics of Lifelong Learning
(adapted from: Bollington, 2015)</th></tr>
<tr><td>Empathy
Focus on the user
demands user-centredness that fosters intrinsic motivation
enhances the ability to embrace ambiguity and adaptability</td><td rowspan="3">Being curious to explore new ideas and avenues for learning
Belief that capability can be developed and improved throughout the life span
Self -motivated or possess intrinsic motivation to learn
Being creative with ideas and solutions</td></tr>
<tr><td>Problem Definition
Wicked or complex real-life problems
triggers curiosity
requires multidisciplinary knowledge application
Framing and reframing of a problem allows for co-evaluation of problem and solution from multiple perspective</td></tr>
<tr><td>Ideation
Brainstorming in diverse teams enables generation of as many solutions from diverse perspectives
Emphasis on open minded (non-judgemental) idea generation enhances ability to accept multiple views
Application of thinking strategies (inductive, deductive, and abductive) enhances ideas and solution derivation</td></tr>
<tr><td>Prototyping
Prototyping offers visual and tangible object to think, experiment, learn from and critique
Prototypes provide clarity & common understanding among team members</td><td rowspan="3">Reiterated learning is essential to build efficacy and mastery
Hard work and continuous effort are necessary to succeed
Perseverance through failure is essential to achieve</td></tr>
<tr><td>Testing
End user testing on prototypes assist to uncover latent needs to reiterate and provide the best solution for the user</td></tr>
<tr><td>Reiteration
Continuous reiterations (creation, engagement & experimentation) build mastery & self-efficacy, creative confidence, and perseverance (patience to embrace failure).
Reiterations enhance the ability to think about one’s own thought processes, adapt, strategize, monitor, and reflect</td></tr>
<tr><td>Reflection
Reflection is a vital component of collaboration-feedback-evaluation-reflection-reiteration loop, a process that is similar to self-regulation of learning
Continuous reflection, enables incremental improvements</td><td rowspan="2">Important to accept feedback to learn and improve
Need to collaborate and learn from others
Need for self-regulated learning to monitor, reflect, evaluate, and improve</td></tr>
<tr><td>Collaboration
Learning happens through collaboration and communication in multidisciplinary teams
Self and others constructive questioning and feedback enhances reflection and reflexivity</td></tr>
</table>

Note: All descriptors are adapted directly from the literatures cited in the table.

This paper aims to explore the value of a constructivist approach such as design thinking on graduate employability in a VUCA environment. Design thinking as a creative problem solving approach has been shown to increase the speed and efficiency of absorptive capacity and organisational learning leading to faster decision making and innovation to survive competition in an uncertain marketplace (Cousins, 2018). Drawing on the results of an empirical study that examined the impacts of design thinking on student learning, this paper explores how design thinking process attributes have the potential to inculcate lifelong learning characteristics in higher education learners.

This study

The empirical study, part of a Master of Philosophy (MPhil) research project (Seevaratnam, 2022), used a multi-method qualitative methodology (Creswell, 2020) and the Planned-Enacted-Experienced Curriculum Model (Matthews et al., 2013) to explore how the process attributes of design thinking that were planned and enacted by educators are experienced by learners in higher education courses. This study further examined how these experienced attributes and the consequent learning outcomes could be aligned to the characteristics of lifelong learning. The research questions that guided the study were:

1. How are design thinking attributes planned and enacted by educators?
2. How do design thinking attributes influence the learning outcomes experienced by the learners?
3. How do design thinking attributes and learning outcomes align with the characteristics of lifelong learning?

The study examined two postgraduate courses (or units of study within an academic program) during one semester or 12 weeks at an Australian research-intensive university, which incorporated process attributes of design thinking: Introduction to Web Design and Principles of Entrepreneurship, henceforth respectively referred to as Web Design and Entrepreneurship. Participants in this study were recruited online and voluntarily from the teaching team (lecturers and tutors) and students enrolled in the courses. A total of 13% (n=18/140) learners from Web Design and 34% (n=19/56) of learners from Entrepreneurship participated in the study. In the Entrepreneurship course, the educator was interviewed as were 4 volunteer students while the educator, 4 tutors and 7 student volunteers were interviewed in the Web Design course.

Figure 1 illustrates the four phases of the study, the inter-relationship between the phases and the four qualitative methods (course document review, classroom observation, individual interviews of students and educators, and students' assessments review) used in this study.

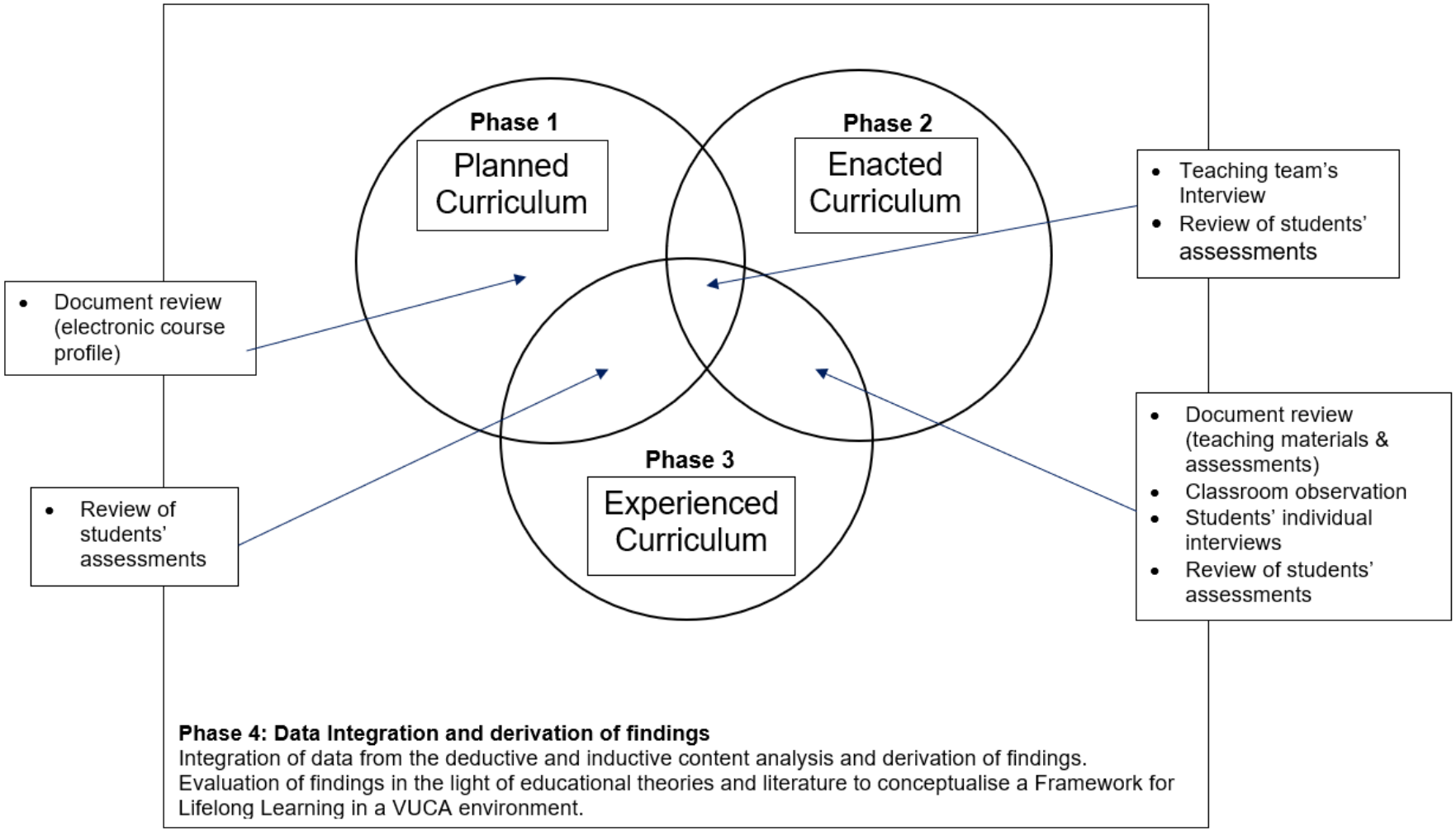

Figure 1: The Inter-relationship Between the Planned-Enacted-Experienced Curriculum and the data Collection Methods Employed

In the first three project phases, data were collected from the three different stages of curriculum: the planned, enacted, and experienced. A number of data collection methods were employed together to enable convergence and corroboration of findings, avoid bias and enhance trustworthiness (Creswell, 2020). Participant observation, archival document review and in-depth interviewing were employed to provide rich description of participants, conversations, and reflections through understanding behaviour from the subject's own point of view. Data were collected in the context of active teaching and learning, capturing learning processes rather than simply outcomes. A final project phase integrated the data obtained in the first three phases and considered findings in the light of contemporary educational research. Human research ethics approval was obtained (Document Approval No: 2019002297) from the institutional Humanities and Social Sciences/Low and Negligible Risk Sub Committee.

A common synthesis tool was developed to standardise data collected to enable systematic comparison across the curriculum and courses - a Course Document Review Framework. The framework comprised the process attributes and sub-attributes of the design thinking approach being examined, including descriptors, distilled from literature (Kelley & Kelley, 2012; Lindberg et al., 2010; The Stanford d.school, n.d.). In Phase 1 and 2, deductive (top down) content analysis was used to analyse the planned and enacted curriculum (Creswell, 2020; Hsieh & Shannon, 2005). Text and images in the electronic course profile; teaching materials; assessment tasks; learner and educator activities and conversations recorded during classroom observations were captured in the framework. Data were inspected for keywords and phrases either explicit or inferred, related and aligned to the design thinking process attributes and mapped onto the framework as whether attribute is present or absent.

In phase 3, experienced curriculum was analysed using inductive (bottom up) content analysis (Creswell, 2020; Hsieh & Shannon, 2005). Students' assessment submissions and interview transcripts (learners' and teaching teams) were scrutinized to identify ideas related to the different process attributes of design thinking, using the descriptors in the framework as guide. Common ideas were then grouped together into themes and mapped onto the same Course Document Review Framework as to whether the attribute was present or absent. In the final phase 4, the data from the top down and bottom up approaches were examined to determine the alignment of the experienced curriculum by the learner to the planned and enacted curriculum by the educator. Examples of evidence were noted to support the interpretation of data. Finally, attributes of design thinking and learning outcomes were inspected against the characteristics of lifelong learning and contemporary educational research. To enhance validity, all data was collected and interpreted by the MPhil student, independent of the educators and learners and where possible evidence was anonymised by a third party.

Findings and Discussion

Examination of design thinking process attributes in the curriculum of the two courses (Web Design and Entrepreneurship) using the planned-enacted-experienced curriculum model highlighted learning outcomes (skills and mindset attributes) and potential payoff traits that were aligned to the characteristics of lifelong learning. In this study, payoff traits are referred to outcome characteristics of implementing the process attributes of design thinking in higher education curriculum. Further inspection of the findings led to three emergent graduate capability themes which together with the associated attributes and payoff traits guided the conceptualization of a Framework for Lifelong Learning in a VUCA environment.

The Planned-Enacted-Experienced Curriculum

Findings from the close examination of the planned, enacted, and experienced curriculum and mapping indicated that the process attributes of design thinking incorporated in both courses were

aligned to the graduate attributes and accordingly enacted by the educators and experienced by the learners. In both courses, learning was driven by a closer to real-life problem (considered closer to real-life since solutions were not required to be implemented in real-life) in the form of a project. The open ended tasks to create a client-centred website for tourist in an unusual location with unusual activities in the Web Design course and a new business venture for any existing real-life problem in the Entrepreneurship course provided learners in each course an authentic experience with the opportunity for imagination and creativity. The hands-on process of creating the website and business venture from scratch, emulating industry practices and abiding by industry standards and best practices encouraged the development of both industry relevant discipline specific knowledge and skills (epistemology) and transferable skills (ontology).

Table 2 illustrates how each of the process attributes of design thinking examined contributed to leaning outcomes (skills and mindset attributes) experienced by the learners and related to three emergent graduate capability themes. These attributes together with payoff traits identified were also found to be aligned to the characteristics of lifelong learning. For example, the process attribute 'Empathy' for the end user had potential for intrinsic motivation (Pavey et al, 2012) while serving as an integral factor in collaboration (Zaki, 2019). Problem definition provided learners' a platform for consideration from multiple perspectives potentiating curiosity (Jordan et al., 2014) and a growth mindset (Dweck, 2017). Collaborative ideation led to exercising of different thinking strategies and encouraging creativity, innovation and creative problem solving. During the prototyping mode of the design thinking process, the development and use of tangible personas and prototypes to think, experiment, obtain feedback, reflect, and reiterate enhanced learner's creativity and empathy for the user. In this study, critiquing/testing peer's prototypes facilitated learner's acquisition of evaluative judgement skills (Tai et al., 2018) and ability to seek, provide and receive feedback towards better teamworking. The repeated reiteration post feedback enabled learners to persevere empowering grit (Duckworth et al., 2007), mastery and self-efficacy (Bandura, 2018) and creative confidence (Kelley & Kelley, 2012). Further, the collaboration-feedback-reflection-evaluation-reiteration loop being similar to monitoring/feedback-evaluation-reflection-improvement cycles of self-regulated learning (Zimmermann, 1990) was a potential characteristic for lifelong learning. Reflection was encouraged throughout the design thinking process (pre, in and post process) facilitating self-awareness and meta-learning (Radovic et al., 2021). Central to design thinking was the interdependence and independence through collaboration in diverse multicultural and multidisciplinary teams enabling enhanced performance, communication, ethics, and cultural awareness. These learning outcomes match the characteristics of lifelong learning such as curiosity, growth mindset, creativity, and intrinsic motivation as essentials to enhance learning, reiteration, and hard work to build mastery and self-efficacy and perseverance to learn through failures. Also sharing and learning from others through collaboration while being self-regulated to monitor, evaluate, reflect, and improve one's own learning (see Table 2).

Table 2: Contribution of the Attributes of Design Thinking to Characteristics of Lifelong Learning

Planned and Enacted (Process attributes)	**Learning Outcomes Experienced** (Skills and mindset attributes)	**Graduate Capability Themes**	**Payoff traits for Lifelong Learning**	**Characteristics of Lifelong Learning**
Empathy	Intrinsic motivation Teamworking	Creative problem solving	Growth mindset Curiosity Intrinsic motivation Creativity	• Being curious to explore new ideas and avenues for learning • Belief that capability can be developed and improved throughout the life span (growth mindset) • Self -motivated or possess intrinsic motivation to learn (willing to take risk to learn and improve) • Being creative with ideas and solution
Problem Definition	Multiple perspectives Growth mindset Curiosity			
Ideation	Thinking strategies (inductive, deductive, and abductive) Creativity Innovation Creative problem solving Teamworking			
Prototyping	Empathy Creativity	Reiteration for mastery, self-efficacy & grit	Self-efficacy Mastery Grit	• Reiterated learning is essential to build mastery and self-efficacy • Hard work and continuous effort are necessary to succeed • Perseverance through failure is essential to achieve
Testing	Feedback to & from others Evaluative judgement Teamworking			
Reiteration	Perseverance/Grit Mastery Self-efficacy Creative Confidence Collaboration-Feedback-Reflection-Evaluation-Reiteration loop			
Reflection	Meta-learning (internalization and transference) Self-awareness	Collaboration & reflection for improvement	Self-regulated learning	• Need to collaborate and learn from others (interdependence) • Importance to accept feedback and learn to improve (independence) • Need for self-regulated learning to monitor, reflect, evaluate, and improve
Collaboration	Independence Interdependence Communication Ethics Cultural awareness			

Design thinking process attributes, graduate capability themes and lifelong learning characteristics

During classroom observations, three graduate capability themes namely creative problem solving, reiteration to build grit, mastery and self-efficacy and collaboration and reflection for improvement were evidenced in practise. These three themes, comprising the eight design thinking process attributes studied had the potential to instil in learners, lifelong learning characteristics (see Figure 2).

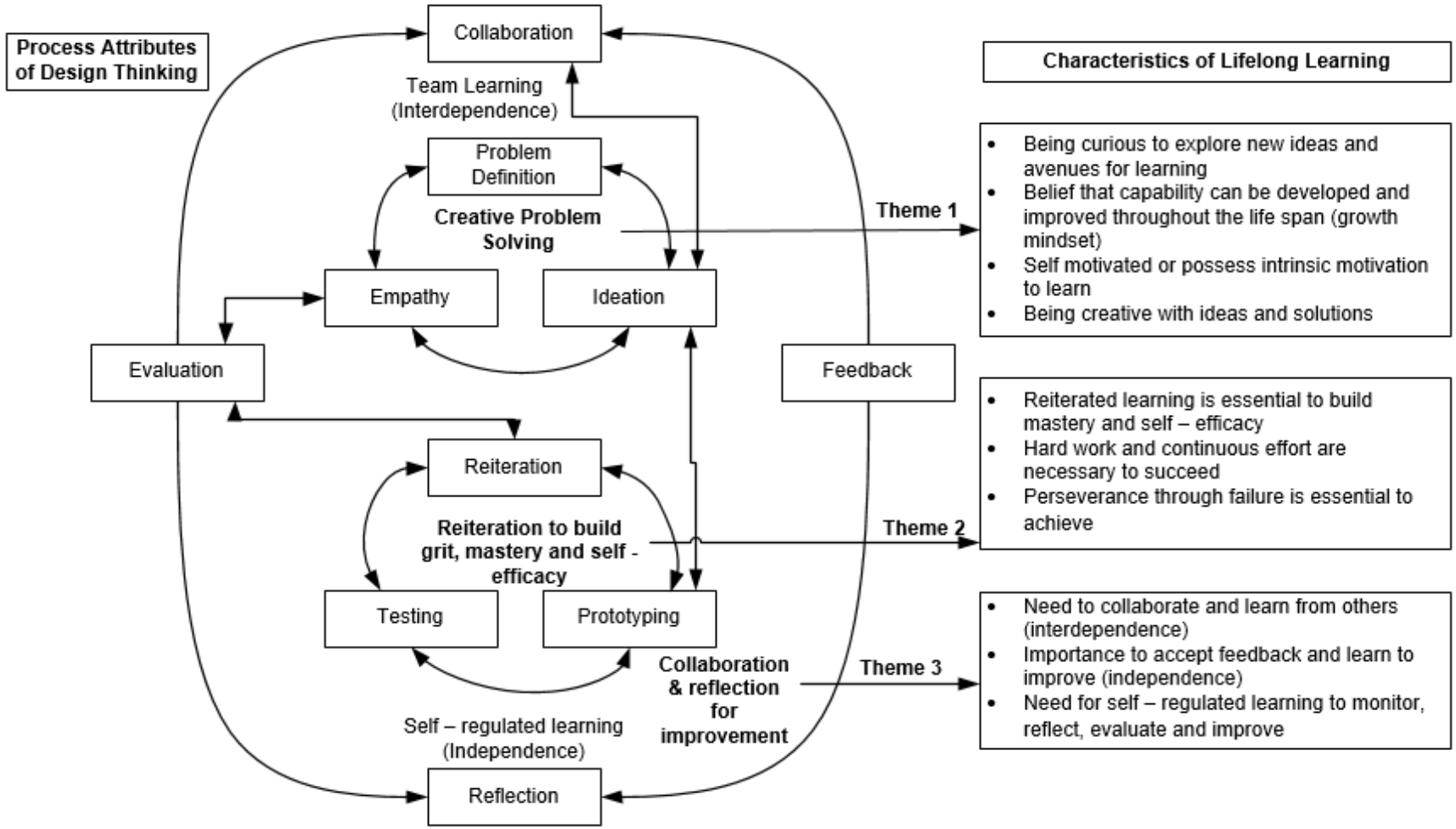

Figure 2: Design Thinking Process Attributes, Graduate Capability Themes and Lifelong Learning Characteristic

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Theme 1: Creative problem solving

In theme 1, the exploration of complex real-life problems has the potential to trigger curiosity (Jordan et al., 2014) while empathy for the user could incite intrinsic motivation (Pavey et al., 2012). Defining the complex problem involves the consideration of multiple perspectives that has the potential to encourage a growth mindset (Dweck, 2017). Arising from framing and reframing of the problem in different context is the enhanced ideation for best fit solutions. Open-minded and non-judgemental ideation and thinking strategies used in turn potentially leads to creative, out of the ordinary solutions that could be prototyped and tested, serving as a link to theme 2.

Theme 1 comprise the first three steps in the design thinking process which is empathy, problem definition and ideation and leads to identification of the problem and derivation of multiple empathetic solutions via free and non-judgemental ideation. In Web Design, theme 1 related to the selection of the themed resort with unusual activities in an unusual location. In Entrepreneurship, this theme was related to the activities towards business pitch 1 where learners identified a current real-life problem and proposed an innovative business model canvas for a new venture.

Learners in both courses valued empathy or user-centredness, gaining the realization that the user's perspective may be different from their own and that the product needs to satisfy the users' needs and not their own as illustrated in the following interview response: 'like being able to understand that what you think is great is not always, how do you say this, like interpreted the same way, you know, to your users, the people that you're presenting to' (Learner 1). The learners also realised that an ideal solution may not also best meet the needs of users: '…in business, you can design anything and everything and the best of the best. But if the end user, the consumer cannot use it, or struggle to use it, then there's no value adding in it' (Learner 2).

Most participants in this study were driven by intrinsic motivation or internal rewards like enjoyment or want as evidenced in students' design reports in Web Design and reflections in Entrepreneurship. For example, a learner, who has not been disciplined in studies, made particular effort in the Web Design because the learner enjoyed the course: '… I've always not been disciplined. […] I've been more disciplined than I would have expected. So yeah. I really enjoyed the course and that's probably why I've been better than I usually would be' (Learner 3). Another in the Entrepreneurship course reflected on his curiosity to find out more: 'When learning about these tools and frameworks, my curious mind led me to researching external information about business models, the value proposition and how to gather customer insight' (Learner 4).

Evident in both courses was the constant emphasis on user centredness by the educator that led to the learners' wanting to create the best solution that satisfies the user. This coupled with the opportunity provided to the learners to design and develop a real-life product/solution from scratch based on their own ideas availed potential to trigger curiosity, growth mindset, creativity, and intrinsic motivations.

Theme 2: Reiteration to build grit, mastery and self-efficacy

The second theme of reiteration to build grit, mastery and self-efficacy is borne of a repetitive cycle in the design thinking approach; used to make incremental improvements to ensure optimum user-centred solutions to problems. This theme aligns to the latter two steps in the design thinking process, prototyping, and testing together with reiteration. Repeated iterations require effort and hard work as well as ability to embrace challenges and failure to learn from mistakes that enhances perseverance (Dweck & Leggett, 1988). In the long term, the repetitive nature enables mastery and confers confidence or self-efficacy (Bandura, 1994). The user-centred, reiterative cycles potentially build creative confidence (Kelley & Kelley, 2012) and grit (Lauff et al., 2018). Reiterations serve as a link back to empathy in theme 1.

Theme 2 enables the possible solution(s) in theme 1 to be prototyped and tested with the user leading to reiteration(s) that optimize the solution to best fit the user needs. In Web Design, theme 2 was related to the in-progress design and development of the idea generated in theme 1 into a client-centred website. Prototypes and users' tests were developed and conducted regularly with peers as simulated users to reiterate and make incremental improvements to optimize user needs, engagement, and experience. In the Entrepreneurship course, theme 2 was related to business pitch 2 where the business model canvas created in pitch 1 was further developed, assumptions tested, and reiterations made to optimize the business feasibility.

In the Web Design course, regular cycles of prototype user testing, reflection, evaluations, and reiterations had potential to enhance mastery and self-efficacy. These self-development opportunities were expressed by learners in interview responses, for example:

> *I'm particularly on the prototype testing and user testing, I think it is very useful. Because I know how to do now, I know how to do prototyping and how to conduct the prototype test. Like I have the questions first, and then we need to see how they're going with the prototype and to think what the next steps will be, like what kind of improvement, so I think that's useful.* (Learner 5)

In the Entrepreneurship course, perseverance was dominant as learners realized that in real-life, to make mistake, fail and learn is acceptable and normal. A learner reflected as follows: 'I think that understanding the real life cases helped us to understand that maybe we could even be working in a project that doesn't solve any real need … helping us to be able to face failure.' (Learner 6)

In both courses, the main payoff traits arising from the repeated reiterations and failures or learning from mistakes in theme 2 are mastery, self-efficacy and perseverance or grit.

Theme 3: Collaboration and reflection for improvement

Collaborations are an avenue for feedback, reflection, evaluation, and reiteration and therefore improvements. Reflection of an experience rather than the experience itself is known to enhance internalization and deep learning (Radovic et al., 2021). Collaboration encourages interdependence while reflection and reflexivity promote independence (Dall'Alba & Barnacle, 2007). The third theme of collaboration and reflection for improvement focus on the belief that diverse perspectives through collaboration creates better solutions (interdependence) and feedback, evaluation and reflection enhance self-improvement (independence). The collaboration-feedback-reflection-evaluation loop is similar to the monitoring-evaluation-reflection-improvement loop in self-regulated learning (Zimmermann, 1990), the practise of the former could potentially enhance the latter. Further, collaboration in diverse teams enhances ideation (Reiter-Palmon & Leone, 2019) and serves as a link back to theme 1. Overall, theme 3 that links to ideation in theme 1 via collaboration and to reiterations in theme 2 via evaluation-reflection is an overarching theme that overlaps with themes 1 and 2.

Throughout the projects in Web Design and Entrepreneurship, the feedback-reflection-evaluation loop that resulted in reiteration for incremental improvements was practised collaboratively with feedback sought/received/provided from peers and others. Learners found the feedback and iterative loop as beneficial to learning and improvement of their project progress, for example as reflected by one learner in the Web Design course.

> *My learning strategy has been changed to the pivoting process that we need to 'Test,' 'Learn,' and 'Improve.' After we develop something, we need to test those things with users or target customers to find what can be improved. After testing, we need to review customer feedback and learn what could be changed to fulfil the customer need. After learning, we need to adapt the website in order to improve the user experience. (Learner 7)*

The three graduate capability themes in design thinking can be employed independently based on need or together to reap maximum benefits. Overall, the main potential payoff traits to learners as a consequence of practising the themes are, curiosity, creativity, intrinsic motivation, growth mindset,

grit, mastery, self-efficacy, and self-regulation. These payoff traits were instrumental in the conceptualization of a Framework for Lifelong Learning in a VUCA environment.

Graduate capability themes and lifelong learning

As illustrated in Table 1, the process attributes of the design thinking approach studied are aligned with the characteristics of lifelong learning, arguably essential to be practised in the 21st century workplace. These characteristics were mapped to the themes in design thinking as illustrated in Figure 2.

Empathy or human centredness in theme 1 has the potential to incite intrinsic motivation, the basis for self-motivated learning. The exploration of wicked problems in problem definition could spur curiosity to search for new ideas and activities for learning. Also, curiosity could trigger self-direction to learn and improve, the potentials to inculcate a growth mindset for learning throughout the lifespan. Further, the collaborative non-judgemental ideation process could encourage creativity for unique and out of the ordinary ideas and solutions, sparking innovations essential for the 21st century.

Theme 2 embodies reiterated learning through the repeated prototyping, testing, and incremental improvements to build mastery and self-efficacy as well as promote hard work and continuous effort that is necessary to succeed. In the long term, the ability to embrace failure and learn from mistakes potentially develops grit and enhances determination to achieve.

The importance of interdependence, independence and self-regulation for learning and improvement is exemplified in theme 3. The ability to accept constructive feedback to self-learn or independence as well as collaborate with diverse others to learn from or interdependence are both valuable for improvement. In addition, the ability to self-regulate one's own learning through the feedback-reflection-evaluation-improvement loop has potential for control and optimization of learning. For example, preliminary studies have shown that undergraduate music students using self-directed practice diaries to plan, monitor and reflect on their musical practise resulted in a more focused learning to optimize performance (Osborne et al., 2021).

Framework for Lifelong Learning in a VUCA environment

The learning outcomes (skill and mindset attributes) and payoff traits arising from learners engaging with and practising design thinking process attributes in the courses studied and its extrapolation to a proposed lifelong learning cycle (curiosity-mastery-self-efficacy-intrinsic motivation) led to the conceptualisation of the Framework for Lifelong Learning in a VUCA environment (Figure 3).

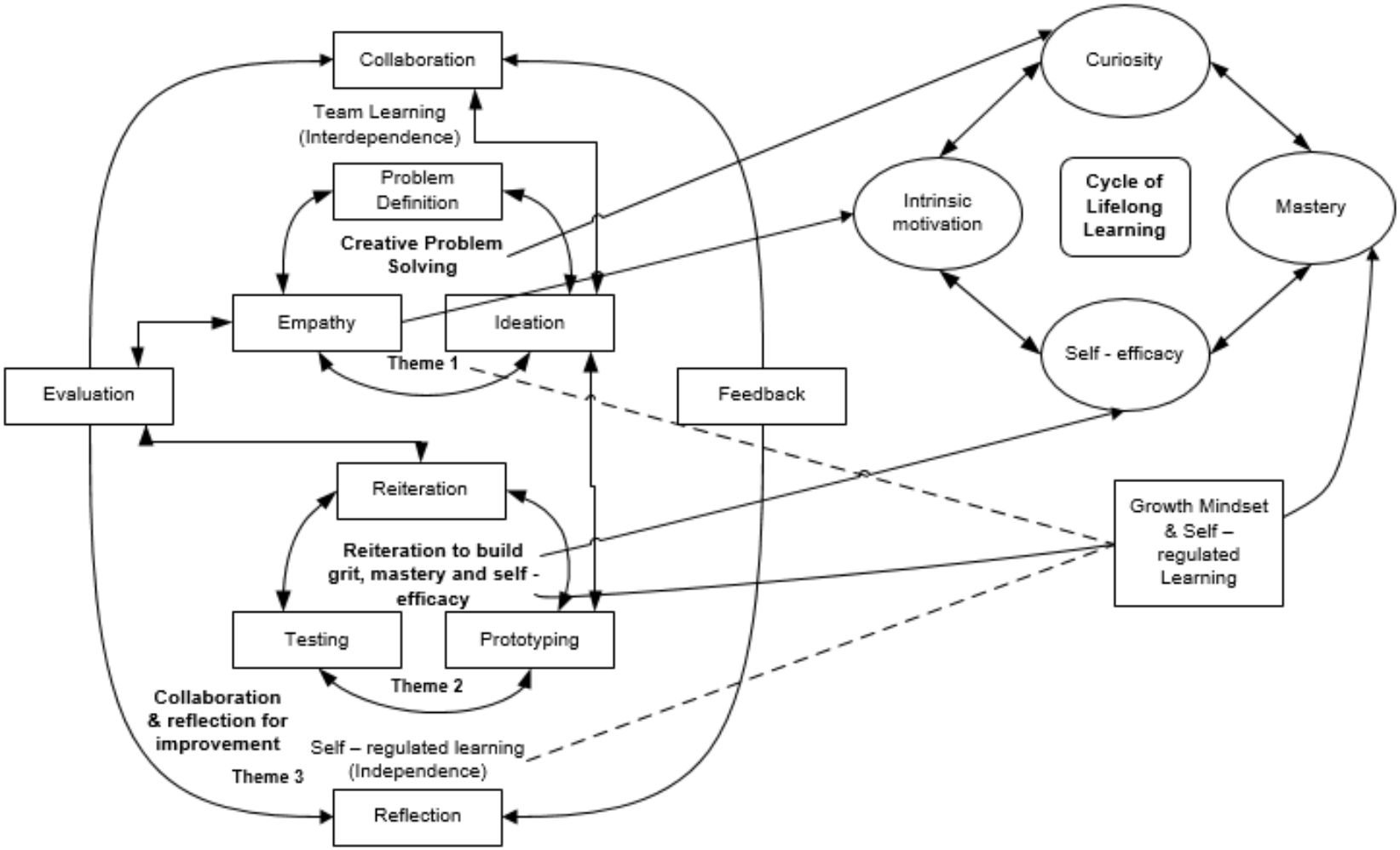

Figure 3: A Framework for Lifelong Learning in a VUCA Environment

Epistemic curiosity to close knowledge gaps has been shown to spur learning and memory (Berlyne, 1954; Brod & Breitwieser, 2019). Curiosity or the desire to learn and discover could provide the 21st century learner and workforce, the ability to adapt and self-initiate to explore new frontiers. Dr Stefan Oschmann, the CEO of Merck KGaA, Germany iterated that 'curiosity fuels business development and enables companies like ours to maintain our competitive edge,' confirming the benefit of curious employees to an organisation (Merck KGaA, 2016; p3). The Merck KGaA report outlines the four dimensions of curiosity as inquisitiveness, creativity in problem solving, openness to other ideas and disruption tolerance or risk taking to overcome fear of mistakes/failure (Merck KGaA, 2016). Practising the design thinking approach has the potential to elicit curiosity. In theme 1, consideration of multiple perspectives during problem definition could arouse inquisitiveness while non-judgemental ideation encourages open-mindedness and creativity. In addition, in theme 2, the user-centred, repetitive reiterative cycles build creative confidence (creative problem solving and disruption tolerance) and perseverance/grit and in turn serves as a link back to empathy. Empathy for the user has the potential to incite intrinsic motivation (Pavey et al., 2012). This non reward based internal motivation is arguably the preponderance to learning across the lifespan (Ryan & Deci, 2017).

However, the learner's mindset is considered instrumental in learning and mastery achievement. According to Dweck's Growth Mindset theory, an individual's basic qualities (intelligence, talent, abilities etc) can be enhanced through effort and is not fixed at birth (Dweck, 2017). In theme 1 problem definition from multiple perspectives and open, non-judgemental ideation encourages exploration of knowledge and application of different thinking strategies which has the potential to inculcate a growth mindset. Instilling a growth mindset in learners could potentially enhance their self-regulation (Mrazek et al., 2018) and intrinsic motivation (Ng, 2018). Further, the characteristics of a growth mindset include enjoyment in learning, ability to embrace challenges as well as persevere to strive harder in the face of obstacles and failure (Dweck, 2017; Dweck & Leggett, 1988). Individuals with a growth mindset who portray effort and resilience would be better placed to succeed in the 21st century volatile, uncertain, complex, and ambiguous environment.

Self-regulated learning or the ability to self-monitor, reflect, evaluate and improve one's own learning has potential for mastery (Zimmermann, 1990). The synergy of growth mindset arising from theme 1 and self-regulated learning from theme 3 contributes to mastery or competence, the knowledge & skills to act effectively. The repeated cycles of reiteration or practise in theme 2 further adds to mastery. In turn, the mastery of knowledge and skills through learning and practise endows an individual with self-efficacy. According to Bandura's Social Cognitive Theory, self-efficacy, defined as people's judgement of their capability to perform a specific task is influenced by personal, behavioural and environmental factors (Bandura, 1994). In theme 2, the repetitive human-centered reiterative cycles of doing have the potential to instil self-efficacy.

In individuals with high self-efficacy, mastery and autonomy (a greater sense volition or purposive striving) are said to incite intrinsic or self-motivation. Self Determination Theory states that self-motivation and mental health is enhanced when the three innate psychological needs i.e. competence, autonomy and relatedness are satisfied (Ryan & Deci, 2000). The design thinking approach employs authentic human-centred real-life problems to drive learning, thereby providing relatedness, together with mastery through reiteration and autonomy related to open ideation and creative problem solving has potential to fuel intrinsic motivation. This intrinsic motivation could trigger further curiosity and learning when exposed to new situations. Thus, repeating the proposed lifelong learning cycle (curiosity-mastery-self-efficacy-intrinsic motivation).

The conceptualised Framework for Lifelong Learning in a VUCA environment illustrated in Figure 3 demonstrates how practising design thinking process attributes in a higher education setting can indeed build the types of lifelong learning capabilities so desperately needed in a VUCA environment. This framework could be incorporated in higher education course or program curriculum to instil in learners' the characteristics of lifelong learning with potential to enhance graduate employability. The framework could also be adapted by organisations and individuals to cultivate lifelong learning skills.

In this study, a few essential implementation aspects were noted in engaging learners to practice the design thinking process attributes and enabling them to experience the said learning outcomes. In particular were authentic real life or closer to real life problems to drive learning, opportunities for collaboration to share with as well as learn from others to creatively solve problems and reiteration for incremental improvements to embrace risk and failure. For example, one educator foresees the benefits of reiteration and therefore design thinking in all disciplines and in uncertain environments such as the 21st century, as he mentioned*:*

> *….So, do I know stuff? No. Could I find that out? Yes. So, let's learn with learning the design thinking way. So, let's do it, fail. Failure is not a bad thing. It is an opportunity to learn, I learned that this doesn't work in this setting. I'm going to try something else. Oh, that didn't work. But it worked a bit better than last time. Oh, let's do it. Again. The intention is as you get better, as you gather more knowledge, you learn more. So, design thinking has a fundamental place, I would say in all disciplines and certainly in navigating uncertainty …* (Educator).

Conclusion

Exploring curriculum in practise using the planned, enacted, and experienced curriculum model has proven useful to examine the incorporation of design thinking attributes in higher education courses. The learning outcomes from engaging with and practising the design thinking process attributes studied has potential to inculcate knowledge and skills including lifelong learning skills necessary for graduate employability. The attributes, learning outcomes and payoff traits identified and conceptualised in the light of educational theories and literature serve as a Framework for Lifelong Learning in a VUCA environment. The agility to learn can narrow the dynamic skills gap due to rapid digitalisation in the 21st century, improve the disconnection between workforce and work, enhance employment and support career development of graduates. Therefore, incorporating design thinking into higher education courses as generic learning in all disciplines could have the potential to develop in learners' capacity to engage in a VUCA environment. The reproducibility of these findings needs to be explored by examining more courses and for a longer duration in varied disciplines and institutions. Further research could focus on the validation and implementation of the Framework for Lifelong Learning in a VUCA environment at educational institutions and organisations or as a self-development tool to inculcate lifelong learning.

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Declaration of interest

The authors confirm that there is no conflict of interest.

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