

***REFLECT: Engaging and Empowering Critical Thinking Through Creative
Process Journals***

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Abstract

Disruption is not only changing the landscape of businesses and the workforce but also pushing learning and teaching approaches to re-evaluate themselves in order for educators to motivate learners to learn in a digital world. In Singapore's tertiary education, learners have moved from the proponents of STEM to STEAM, where an integration of the arts is embedded in most curricula to develop capabilities which are important to a future-ready workforce. Undergraduates must now possess combined competencies, such as problem-solving, creativity and critical thinking. This paper aimed to propose a practical framework underpinned by propositions of the reflective practitioner championed by Donald Schon, with discussions on how the Creative Process Journal (CPJ) is primed by critical and reflective thinking. Its research method would include looking at case studies and gathering insights from the CPJ, a mandatory Unit Of Assessment (UOA) of the main module of a Bachelor of Arts (Hons) programme in Singapore. For the UOA, students would be assessed if they could successfully analyse design paradigms and practices to develop a critical understanding of contemporary design culture as the learning outcome. The paper also aimed to demonstrate positive results of how its students are able to form iterations of creative output through risk-taking, collaboration and experimentation. The pedagogical approach of this study would then be able to nurture future competencies and support strategies for students in other disciplines to enable the scaffolding of the creative process in order to facilitate critical thinking through critical making.

Keywords: Critical thinking, reflective thinking, creative process journal

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Introduction

Singapore's education system is known for its achievements in delivering quality education. This system is strong because students aim high and often achieve good results that is recognised around the world. The core subjects taught in primary and secondary schools prepare learners for tertiary education. (Ministry of Education Singapore, n.d.) Progressing onwards, the Science, Technology, Engineering, Arts and Mathematics (STEAM) empowers students to be capable of making informed decisions and to find alternate solutions for problems that the real world is facing. This mode of learning is inspiring and engaging because it can relate better to the real world, hence, moving from STEM to STEAM education becomes complementary.

With that said, how do Educators continue to prepare learners in tertiary education with emerging 21st century competencies? Singapore's Ministry of Education produced a framework that list 'Global Awareness', 'Cross-Cultural Skills', 'Critical and Inventive Thinking' as competencies that will enable our youth to find themselves new opportunities within the new digital age. (Ministry of Education Singapore, n.d.) Additional to this, the skills future framework designed by the Government of Singapore maps skills and competencies for designers and signals design thinking practice, critical thinking, sense-making, empathetic thinking, as core skills to attain. (Skills Future Singapore, n.d)

Collectively *"The institutes of higher learning (IHLs) here are set to infuse a wider appreciation of design into their curriculum at a time when job scopes are changing and demand is rising for people with design skills."* (Ang, 2019) While all these are intended and prepares the nation for the future, the aims and curricula and approach to Design Education has been honing these skills for a long time. While design education is not a factory that churns out artists, but has been serving as a platform for young people to discover, enhance and pursue the alternate career choice. Design education has been teaching students to develop critical thinking and creative expression, nurture self-development and leadership qualities. A World Economic Forum report, The Future of Jobs 2018 looked at the employment, skills and workforce strategy for the future and it listed the top 3 skills, complex problem solving, critical thinking and creativity. (World Economic Forum, 2018) This connects with what David Ross wrote in "Getting Smart", that the future of work meant having analytical skills needed to generate meaningful insights, know persuasive communication and able to reflect critically on learning experiences and processes. (Ross, 2019)

Design schools have been cultivating independent learners and thinkers for a while now, *"for the business world, design thinking might seem like a new concept from this side of the millennium, but within design research characteristics of designers' work and practice have been discussed for at least 40 years, while the management discourse of design thinking developed over the last decade is only slightly related to the earlier discourse."* (Johansson-Sköldberg, 2013)

With that said, one of the key learning outcomes of a good design education is for learners to practice iterations of the creative process. The focus of the creative process in the design school is nothing new. This method of learning enabled design students to understand the value of the creative process is often a journey that is rewarding,

especially for projects that have “process” and “reflection” as core components. The BA(Hons) Design Communication Programme in Lasalle College of the Arts has a component called the Creative Process Journal and it was created and used by students to explore their processes of creativity and innovation.

Research objective:

The paper studies the pedagogical approach on how critical thinking occurs during the design process and how has it been taught to students in LASALLE for the BA(Hons) Design Communication Programme. It presents a framework on how the Creative Process Journal (CPJ) is primed by critical and reflective thinking, in turn, supports the main modules of the course.

Research Methodology:

Secondary research includes readers from various scholars who are pioneers in concepts of being reflective practitioners and the importance of building criticality in design education. The readers are benchmarked against the setting of a Singaporean education system to review how design education has been evolving towards. Primary research builds a case study to examine the CPJs produced between 2017 to 2019. The case study conducts an in-depth investigation on a group of final year students to explore the underlying principles of the creative processes for their final year projects to uncover insights and/or information.

Body:

Literature Review -

- a) Design Education in SG - Charting the future of design by Design Singapore Council

The 2025 design masterplan vision for Singapore is to be a thriving innovation-driven economy and a lovable city by design. The Ministry of Communication and Information appointed a panel called the Design Education Review Committee in August 2017 to create strategies that can strengthen design higher education as well as benefit Singaporeans from design-led creative thinking skills. (Design Singapore Council, 2019)

The report endorsed how design can be placed into the national mindset as an essential life skill that can qualify Singaporeans to navigate complex problems that might occur in the complex 4th industrial revolution. The 5 core recommendations in the report aims to advance design education in Singapore and these strategies empower Singaporeans to appreciate the value of design and apply them to their work. (Design Singapore Council, 2019, p. 16)

The 2025 vision is an innovative driven economy to drive Singapore. Recommendation 2, *‘impart design-led skills to students across more disciplines’* encourages design-led creative thinking not only a 21st-century competency skill but also a valuable life skill. This pushes away the old adage where, *“individuals often view design as a technical skill or a purely aesthetic tool, and fail to recognise its*

potential to intersect with or bring value to non-design areas.” (Design Singapore Council, 2019, p. 35)

b) Skills Framework for Design (Singapore)

The SkillsFuture Framework for Design, established by The Future Economy Council Chaired by Deputy Prime Minister & Minister for Finance Mr Heng Swee Keat, drives the growth and transformation of Singapore’s economy for the future. This platform guides Institutes of Higher Education as well as creators of continuing education to develop and future proof of their curriculum. The skills and competencies listed for a designer has been identified for each of the job roles fall under two broad classifications: (i) Technical Skills and Competencies, and (ii) Generic Skills and Competencies. Listed under the category of ‘Analytical Thinking’, it further iterates critical thinking as, *“Examine, manage and connect issues and ideas from multiple perspectives to identify reasoning in a variety of fields with differing assumptions, contents and methods”*. (Skills Future Singapore, n.d)

c) EDUCAUSE: The Horizon Report - Higher Education Report 2019

The Horizon report mentioned significant challenges like adopting more technology in higher education and institutions to re-examine the academic and social needs of the students. The shift to student-centred learning and providing student learning experiences to connect with other disciplines are key concepts and one of these solvable challenges discussed how improving digital fluency and well as meeting the demands for digital learning experiences and instructional design expertise (Educause, 2019, p. 5) While the main discussion based itself around technology literacy, it also advocates that the 21st century learner thrives on the appropriate use and integration of technology.

d) Designerly Ways of Knowing - Nigel Cross

His seminal book, ‘Designerly ways of Knowing’, examines how designers think and make decisions that is different from other professions. He was keen to find out unique influences for ways of thinking in the design practice that help construct design thinking. The concept of ‘designerly ways of knowing’ emerged in the late 1970s with the development of new approaches in design education. Since then, the field of study has grown considerably. Succinctly put, *“The thinking processes of the designer seem to hinge around the relationship between internal mental processes and their external expression and representation in sketches.”* (Cross, 2007, p.53)

e) Donald A. Schön - The reflective practitioner

Schön, a philosopher and urban planner, defined reflective practice as the practice by which professionals become enlightened by their implicit knowledge base because they learnt from their experiences. Donald Schön with Horst Rittel and Herbert Simon are amongst the early contributors of cognitive design theory. The reflective practitioner is a key text in which Schön formulated his theory about reflective activity, knowing in action and reflection in action. He argued that reflection *“is susceptible to a kind of rigor that is both like and unlike the rigor of scholarly research and controlled experiment”* (Schön 1983, preface ix).

f) Teaching Design - Meredith Davis

Meredith Davis is a professor that writes about Design based teaching. Davis embodies meaning onto why self-assessments and class critiques are key in learning. Through critiques and peer to peer evaluation, an activity that is common and necessary in a classroom, can engage the learner differently. *“It is equally important to be specific in class critiques and to develop in students the ability to make detailed evaluation of peer work. The critique is a time-honoured tradition in design education - a feature of the signature pedagogy...”* (Davis, 2017, p.134)

Key Research Inquiry -

The research questions studies the effects of the creative processes and proposes a clarification of a framework to support critical thinking. The questions are 1) How do designers approach critical thinking in their creative processes? This question aims to uncover the motivation behind the creative process and how students achieve learning outcomes. 2) What is critical thinking in the practice of design and how can it encourage and innovate creative output? This studies the underlying effects of a Singaporean education and 3) How can the Creative Process Journals empower and foster future competencies? This question aims to gain insights from the CPJs to read the processes that value risk-taking, collaboration and experimentation.

Discussions –

a) What is the Creative Process Journal (CPJ)?

The CPJ was created as a required design outcome in 2005. The programme envisioned how the CPJ should move away from the adage of the sketchbook. The CPJ was meant to collate the invisible but yet crucial processes that informed the design practice. This practice mirrors Schön’s reflective practitioner and puts into context of how designers need to frame the problem and what it means to gain professional knowledge and reflection in action. (Schön, 1983)

The CPJ resides as a single unit of assessments that maintain a healthy balance within the module. The CPJ critically assesses all research findings and development of ideas and concepts, as well as the application thereof. The marking criteria for the component accounts for 20% of the module and resides as a unit of assessment. The learning outcomes aims to build essential skills and competencies that feed into the ecosystem of design education and for Lecturers to identify what students will know and be able to do by the end of the programme during Assessments. Through such requirements, students critique existing design paradigms and practices and develop a critical understanding of contemporary design culture. Hence, this endorses the recommendation of Schon’s, *“...then the practitioner may surface and criticize his initial understanding of the phenomenon, construct a new description of it, and test the new description by an on-the-spot experiment.”* (Schön, 1983, p.63)

b) From prescriptive to self-initiative

Professor Nigel Cross wrote about how Engineers and Scientists tend to systematically work to understand the problem. While designers explore the problem

and propose a variety of possible solutions and then work towards finding a solution that is satisfactory. *“The evidence from the experiments suggests that scientists problem-solve by analysis, whereas designers problems-solve by synthesis; scientist use ‘problem-focused’ strategies and designers use ‘solution-focused’ strategies.* (Cross, 2007, p. 22) In early 2007, the Creative Process Journals iterated sketch forms, the study of printed matter and note-taking as structures of inquiry. This was instructed to students to move away from just producing sketchbooks, and to begin to question the creative process instead. Lectures and prescriptive assignments were provided to the students in order for the shift in mindset.

Case Study 1 - Creative Process Journals (CPJs)

A range of final year students’ Creative Process Journals has been collected to study how students work on their independent creative process for their final year project. This analysis is based on their method of documentation, ability to critique and reflect on their own practice and how they articulate their processes which in turn informs the Lecturers during Assessments.

Parameters to set the study:

1. Context
2. Methodology of inquiry
3. Data that signifies criticality and reflection
4. Discovery or insights

The parameters indicated above was used as a guideline to study how students embark on research. The first step was to analyse how student understood the context of the research they’ve selected, followed by the methods students used to perform inquiry and collation of data that determines criticality and reflection through the creative process. Lastly, new findings and insights to provide future recommendations for enhancement.

A study of creative process journal reflections and insights based on 5 students		
Timeline	Reflection by students	Insights
Week 1-6 (Work in Progress)	<p><i>“Made the mockup from scraps of leftover material laying around the house. There were no definite dimensions planned except what’s convenient [.....] Had to redo the box compartments three times because I forgot to [...]. ” - Ng Pei Ling</i></p> <p>-----</p> <p>-----</p> <p><i>“Earlier on in the discussion [...] mentioned on the point that how will the complexity of my project be solved in terms of designing logotype and also adhering to both the</i></p>	<p>Critical thinking occurs when they start asking questions or begin experimentation, “The work of the practicum is accomplished through some combination of the student’s learning by doing, her interaction with coaches and fellow students, and a more diffuse process of ‘background learning’”. (Schön, 1987, p.38)</p>

	<p><i>English and Chinese logo-type methodology. From here, I begin to explore and look into how English logotype is developed and build a few case studies which will help me organise the methods together.” - Chen Zhi Liang</i></p>	
<p>Week 7: (Work Check Week)</p> <p>The Work check week requires students to present their work to the entire student body and teaching team.</p>	<p><i>“Another idea I explored was a possible application of a lino-stamp or print [...] I thought to use the same but [...] Since I’m not well versed or even familiar with etching into hard materials, I decided to try it out with lino rubber sheets, as seen in the following pages.”</i> - Ng Pei Ling</p> <p>----- -----</p> <p><i>“During one of the interview sessions, one of the local brand owners asked, “Why did you choose such a topic? The local street scene is rising, yes. But with the help of global brands. The local brands are not doing anything to create noise for Singapore. That’s why I decided to bring in global brands to market my own line-up.” - Jerome Yap</i></p>	<p>From here, we can see that students gained confidence through self led reading and by being able to evaluate skill set, “reframing the problem is also a reflective conversation with the situation...and then to develop the implications of a new whole idea.” (Schön 1987, pp.58)</p> <p>-----</p>
<p>Week 8: Mid term break (Project Week)</p> <p>- Self Assessment as a form of reflection and students catching up on what needs to be done to speed up with work progress</p>	<p><i>“I went and experimented with creating my own sci-fi-ish/futuristic font for this poster. Made to different types of font, one very tall and condensed version with an extremely high x-height ↑ and a thinner, slightly wider, but still tall version with a “pregnant” “R”. [...]”</i> - Ng Pei Ling</p> <p>----- -----</p> <p><i>“After the work-check, [...] also added on how I should be even more critical with each deliverable—question and challenge its forms. There are things that I could have improved on too, such as the details within the collage and probably done with more attention to it.”</i> - Jessica Emily</p>	<p>This week is a personal week to catch up with projects: Realisation on what needs to be done to speed up with work progress</p>

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Return to Term 2 - Ideate -> Prototype	<p><i>“Brainstorming processes are as important as the results. Thus, I always begin by questioning myself about my project; who, what, why, when, where and how. These are basic steps that I needed to jot down to gather all my thoughts. The sketching and brainstorming process helped me to articulate my ideas better, with a clear and solid concept.”</i> Jessica Emily</p> <p>-----</p> <p><i>“As I tried to edit the illustration, I played with the different line weights and preferred the relatively thinner look. Moving on, the next step would be the layout for the final design of the photopolymer plate. On a side note: I had also stretched the individually drawn sugarcane to make it longer as I felt like the one that I drew in my sketchbook seemed very thick and stumpy.”</i> - Zoe Yan</p>	<p>Students embark on different considerations of all iterations -</p> <p>“Seeing as it not enough, however. When a practitioner sees a new situation as some element of [her] repertoire, [she] gets a new way of seeing it and a new possibility for action in it...” (Schön 1987, pp.68)</p>
Week 12 (Open Studio Week) - Peer to Peer Feedback	<p><i>“In consideration with my website and the way it is design, I tried out with two different variations of the design to see which fits into my design more. I come to a conclusion that a search button is not necessary for the UX but it fit nicely into the UI. I will be keeping the search button and improve on the microcopy of the search field.”</i> - Chen Zhi Liang</p> <p>-----</p> <p><i>“Different trials were done in order to push the boundaries of how one can possibly communicate visually. The different experiments are done based on different chain of thoughts and hence result-ing different execution.”</i></p> <p>- Jessica Emily</p>	<p>She reflected on knowledge and understanding for a situation that has led her to adopt a particular course of action or how her peers have provided her clarity or alternatives. This may have re-framed the problem she is trying to solve, or on the role she has constructed for herself within a larger institutional context. (Schön 1983, pp. 62)</p>
Week 13 - 15 (Assessment)	<p><i>“The biggest challenge here is to create a poster with two dates and timing. Due to the</i></p>	<p>Doing and thinking are complementary -</p>

<p>- Individual Consults, weeks leading to Summative Assessments</p>	<p><i>two phases of the showcase, the poster need to show the two different timing and date. Information can come in as too heavy and confusing for the readers. The best way to do perhaps is to split it to two different poster.”</i> - Chen Zhi Liang</p> <p>----- -----</p> <p><i>“I have learnt that holding a showcase requires a lot of meticulous planning. It was important for me to plan the layout of the space and how I wanted people to move around from station to station. I had to plan how to place every pedestal in a properly allocated space in order to ensure the guests would fully understand the project.”</i> - Zoe Yan</p>	<p>(Reflection in action) Doing extends thinking and in this case, time management, consistent work flow and making decisions independently have been made known and with boundaries (Schön 1983, pp.280)</p>
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Insights from Case Study 1: Realisation as a ‘creative leap’

The students critical analysis in the CPJ have provided a certain reflection of the practice and the realisation of their own learning curves. They have provided detailed explanation of how such an event occurs as a sudden insight, in which they recognised a learning event as a significant increment to the process. This occurs when students have a retrospect of their own design process and are able to identify a point during the design process at which the key concept began to emerge. Kees Dorst wrote in the ‘Creativity in the design process: co-evolution of problem–solution’, that “creativity in the design process is often characterised by the occurrence of a significant event - the so-called ‘creative leap.’” (Dorst & Cross, 2001) Students indicated how such an event occurred as a sudden insight and most of them recognised the learning event as a significant increment to the process.

Proposed Framework to support critical thinking in the creative process

<u>Modes of Approach</u>	<u>Types of Articulation</u>	<u>Processing information</u>
Visual Research	A study of: Objects, mood boards, drawings, photography, film analysis, illustrations, videos, environments, buildings, people, etc.	Methods used to process: Sketching, drawing, writing, photo taking, Mood Boards, etc.
Readers or Literature Review	Beyond required reading: personal interest topics, observations, data gathering, polling, readers from the community, online content, audio/visual, movies, current news, magazines, reports, etc.	Methods used to process: Data collection, annotated bibliography, bite size information gathering, content analysis, etc.
Ideation, Processes and/or Techniques	Discover and Ideation Process: Body of Sketches, drawings, inking, etc. Techniques: digital tools, software, production methods, etc.	Methods used to process: Sketch noting, writing, mind maps, Gigamaps, concept maps, visualisation, etc.
Creative Prototypes, Iterations or systems of testing	Using methods or systems of craft: Making, craftwork, reverse engineering, hacking, material study, composing, experimentation, prototypes, etc.	Methods used to process: 2D or 3D mockups, printed matter, raw materials, processes, user testing methods, etc.

(Figure 1.1)

Figure 1.1 is a proposed framework to guide design students to better connect theory to practice with critical thinking. Some learners are natural critical thinkers, while other learners need to be taught, but both kinds of individuals will benefit from learning how to think critically. In the field of design, it would involve observation, understanding, questioning, concluding, and iterations. Whilst this framework aims to provide a guideline to students to critically analyse & perform reflection to different design processes as well as the self-evaluation.

Within the self, there is a discovery of challenges whereby determined by failures and successes, the capacity to build core understanding of subject matters, to build upon a reflective practice, gather and collate discussions and data points and explore types of collaborations. Additionally, critical thinking is the ability to think clearly and rationally, understanding the logical connection between these ideas. It is also described as the ability to engage in reflective and independent thinking. (Piotrowski, 2011, p.1-9)

Case Study 2 - Reflective Journals

A range of final year students' Reflective Journals has been collected to study how students work on their independent creative process for a 3 weeks immersive workshop which introduces research methods for design practice and digital content generation. This analysis is based on their ability to critique and reflect on their own practice for the final year project.

Parameters for the study:

1. Context and relevance of workshop
2. Introduction to 'working' framework to support critical inquiry
3. Student's methodology of criticality and reflection
4. Discovery or insights

Students were provided with mini-lectures to facilitate the core of the workshop that aids in the production of a designed outcome. The students were provided resources and tools such as extra readers, examples of best practices, and in-class assignments. The proposed framework (Fig 1.1) was presented to explain how students can begin on this process and eventually for them to design a working methodology of their own to lead the inquiry.

A study of creative process journal reflections and insights based on 5 students		
Timeline (Stages)	Reflection	Insights
Workshop 1 (Design Road Mapping) - Design research methods - In-class assignment	<p><i>"However, the fact that I could and was able to find so many of such images makes me realise that people are looking forward, that designers, are probably using the trend topics technique to see what trends were hot are what is not at that moment, and probably then learning on how to develop those trends that are "not hot" as I learnt also that those trends at the bottom of the list are usually those with the most potential to be the next trend."</i></p> <p>- Aretha Cheong</p> <p>-----</p> <p>-----</p> <p><i>"Creating the publication had enabled me to relook at previous connections I thought were strong: with the visuals I have, I realised I might not have enough to maintain the thread of comparison between traditional luxury brands, new luxury and copied goods. Do I want to</i></p>	<p>The designerly way of knowing is not only embodied in the process of designing but equally the products of design also carry knowledge. (Cross, 2007)</p>

	<p><i>maintain this approach for all the items featured? How would I progress then - using colour or do I want to merely stick to black objects in its varying categories [...]”</i></p> <p>- Joseph Kwok</p>	
<p>Workshop 2 (Content Generation)</p> <ul style="list-style-type: none"> - Content planning method - Group critique 	<p><i>What I noticed thereafter, that I wasn't feeling the planned sequence(s). It felt rigid, and stagnant, despite the variation of visuals in alternating posts. Perhaps it is the clash between analogue imagery and crisp pictures of products? Moving on, I decided to think about rationale and sequence as I went along: the posts before and after the existing post, for example, would be varied for the current post.”</i></p> <p>- Joseph Kwok</p> <p>-----</p> <p>-----</p> <p><i>“The feedback proved to be important, guiding me in a new direction. After much confusion and uncertainty I decided to shift my focus onto fabrics, textiles and how silhouettes affect our perception of masculinity.” - Shree Narain</i></p>	<p>The three main stages of critical thinking for designers: Observe, Question, and Answer. (Elmansy, 2017)</p>
<p>Workshop 3 (Digital design experiences)</p> <ul style="list-style-type: none"> - User experience - Group critique 	<p><i>“ I would say that the workshop really did help a lot in the thinking and creating process, especially because in the workshops I created after learning about “something”. The “something” referring to a certain kind of knowledge about the world, about my audience, about technology and about experiences.”</i></p> <p>- Aretha Cheong</p> <p>-----</p> <p>-----</p> <p><i>“In order to understand the process in which the consumer would or should interact and engage with the company, I looked at these few segments to</i></p>	<p>Small Group Critiques: “...under this strategy, students talk about work in greater depth and are more critical than in the public settings of a full class critiques.” (Davis 2017, p.136)</p>

	<p><i>understand the process that brands can better interact with the consumer through their brand messaging.” - Joshua Yeo</i></p> <p>-----</p> <p>-----</p> <p><i>“Having a small class was the best aspect to this. Sharing ideas, group discussions and individual attention to detail really helped us all get more involved in each other's work and gave us fruitful work and hours spent at the end of the workshop.”</i></p> <p>- Shree Narain</p>	
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Conclusion

Critical thinking and reflective thinking has always been part of design education. Students may not be aware of their practice until the end of a project or the programme, therefore, this means that attention needs to be paid to lessons that significantly iterates risk taking, advocate the acceptance of failures and collaborative work to become more evident. Donald Schön equalised Herbert Simon’s description of a “Science of design” by explaining how designers deal with messy, problematic situations that demand intuitive and reflective practices and common design problems has uncertainty and values in contrast to the well-formed questions of science. (Schön, 1983) The proposed framework (Figure 1.1) aims to guide students to reflect on a deeper level, and through the Creative Process Journal, they have demonstrated different stages of reflective learning.

It is important to develop an understanding of assessment literacy for students. This means explaining the module learning outcomes and Lecturers must provide clarity for the assessment criteria, facilitate checkpoints throughout the semester with peer to peer assessments, informal and formal feedback channels.

It is also pertinent to shape a sense of awareness in students for transferable skills like, self-directed learning, active engagement, active planning, and being able to accept feedback in order to direct the learning so that it supports risk taking and innovation. Being a reflective thinker can empower independent learners to develop core skill sets and attain professional attributes such as research skills, team work, communication skills, analytical and problem solving skills.

Further Recommendations

- a. Technology can empower as a tool:

The physical Creative Process Journal eventually becomes a form of mindful assessment of the creative process for every design student. This mechanism was used

to support and nurture creatively independent critical thinking and learners, however, with the advancement of online learning tools and resources, for example, students & lecturers can track real time online writing, create mood board mapping through online platforms like *Pinterest*, *Canva*, *Milanote*, etc. There are many possibilities and tools out there that could empower the creative process and critical learning can also occur in these spaces.

b. Critical Making in Design Practice:

There are many support strategies available for students in other disciplines for them to learn how to scaffold their own creative process in order to facilitate critical thinking through critical making. Critical making refers to the hands-on productive activities that link digital technologies to society. It was invented to bridge the gap between creative physical and conceptual exploration. Matt Ratto commented in 2008, "*Critical Making can be introduced to those in fields of communication, information studies, science and technology studies.*" (Ratto, 2008) Critical Making is the combination of critical thinking with hands-on making—a kind of pedagogical practice that uses material engagements with technologies to open up and extend critical social reflection. (Hertz, n.d.)

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