

Consolidation of concepts from education and health sciences to develop critical thinking skillsets in an undergraduate Life Design setting with promise for wider contexts

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Abstract

Critical thinking is essential for life success. Life Design's rich reflective culture presents opportunity to pursue critical thinking learning outcomes. Concepts from the education literature and applications from health sciences can serve as a prototype to develop critical thinking learning outcomes in Life Design. One opportunity is to describe the elements of Life Design that fit an existing model of critical thinking. The learning outcome is the thought process of reflection – a lifetime skillset. Reflection is critical thinking. The learning guide in Life Design calls for response to each assigned reflection, with follow-up reflections adding depth/escalation to the original reflection. The sequence for each session: narrative engaging students in life situations; guide reflection themes; students enter weekly reflections; assessment on completion of learning outcomes. Themes for the eight weeks: someone inspired you; five to seven important life moments; memoir of fifty, twenty, six words; magician's list prompts memoir; five to seven new things; situation you made better; issue you care about; frame your life, last sentence. 280 of 300 students completed assignments. 95% mastered/internalized reflections. Distinct reflection patterns were evident each week. The eight themes brought an escalation of reflections through the eight weeks. The critical thinking learning model emulated the intended activities. Concepts with an explicit example of applied critical thinking add to the culture and methodology of higher education. Results are in the context of developing critical thinking outcomes to develop additional critical thinking skillsets into a symbiotic network for critical thinking.

Introduction

Critical thinking is an essential skill (McMurtrie, 2018) and an essential component for success in life. (Aston, 2024; Johnsen, 2022) Much in critical thinking is happening yet little has been analyzed. There is no national consensus or national agenda on defining the learning outcomes, guiding learning, and assessing performance for critical thinking skills. The rich reflective culture of Life Design presents an opportunity to pursue learning outcomes for critical thinking. Concepts from the education literature and applications from health sciences can serve as a prototype to develop critical thinking learning outcomes in Life Design. One opportunity is to describe the elements of life design that fit an existing model of critical thinking. A next opportunity is to describe a life design course in the framework of a critical thinking model.

It is unlikely that a diffuse national consortium will develop widely adopted learning outcomes for critical thinking. More likely will be a concerted agenda from a group using a learning model for critical thinking developing learning outcomes. The existing rich Life Design culture offers and opportunity for developing critical thinking learning outcomes in themselves and outcomes adaptable for wider use. While the Life Design mindset offers a rich culture of reflection and exchange, "...the literature lacks a comprehensive theoretical synthesis and rigorous empirical evaluation of outcomes." (Davis, 2025) Several factors are arrayed to consolidate development of learning outcomes and assessments for critical thinking: 1) Concepts on "complex thought processes" from the education literature, but with no applications, 2) A rich culture of intuitive critical thinking in the health sciences and, until recently, no

conceptual basis for critical thinking outcomes, 3) A rich culture of “curiosity,,,reframing...biases... mindfulness and collaboration” from the life design efforts (Davis 2025) and 4) Receptivity to a model for critical thinking learning outcomes that can be contextualized for wider use to other settings calling of critical thinking. A central concept in developing learning outcomes for critical thinking is application of a designated thought process to an identified situation where the thought process becomes the learning outcome, the learning guide and the assessment instrument. The life design culture is a fertile place to consolidate these factors.

The central purpose of this paper is to develop learning outcomes for critical thinking for undergraduates in one setting as a start with potential for wider use in undergraduate education. The central purpose will be to consolidate 1) concepts (without applications) from the education literature on “complex thought processes”, 2) intuitive critical thinking ideas and recent application of education literature to the health sciences for explicit critical thinking skillsets, and 3) the rich culture of reflection on one’s creativity in a life design setting, to begin a process for an explicit critical thinking skillset for undergraduates with potential for wider contextual usage.

The parts of the paper will be 1) articulate concepts on “complex thought processes” from the education literature with promise for use in undergraduate education, 2) explore application of explicit critical thinking skillsets from the health sciences with promise for use in the undergraduate setting, 3) focus on characteristics of the life design culture with promise to develop learning outcomes, learning guides and assessments from 1) and 2), 3) demonstrate in detail the application of concepts in critical thinking to a life design setting, and 4) explore next steps for a wider context for critical thinking outcomes for undergraduates.

Basic concepts from the Education Literature on “Complex thought processes”/ for an emulation model for critical thinking are (1) Engage the student in multiple situations calling for critical thinking; the more such situations, the easier the student will adapt to the next one. (Cronbach et al., 1997; Stone and Hansen. 2000) (2) Emulate the intended activity, with the more direct the emulation the greater the validity. (Lane and Stone, 2006, Fredericksen and Collins, 1989; Baron, 1991; Bauer, 1981; Clauser, 2000; Messick, 1994; Marzano et al., 1993; Shavelson et al., 1999) The concept of novice to expert comes into play as the expert has highly structured but intuitive thought processes and the novice needs some structure. (Marshall et al., 2017; Benner, 2001) (3) Gain agreement of faculty on the content, application, and assessment for reliability/reproducibility. (Clauser, 2000; Marzano et al., 1993, Haertel and Linn, 1996) (4) Use the same instrument to guide leaning and assess performance. (Messick, 1994, Shavelson et al., 1999; Haertel and Linn, 1996; Kane et al., 1999) Thus, the thought process or act of reflecting becomes the learning outcome, the learning guide and the assessment instrument.

A learning model for critical thinking for the health sciences was developed from ideas in the Education literature. (Lane and Stone, 2006; Johnsen et al., 2012; Johnsen et al., 2025) With little literature on learning outcomes for critical thinking and no explicit models for critical thinking guidance and assessment in 2010, ideas from the education literature on emulation were synthesized and first

published in the dental education literature in 2012. (Lane and Stone, 2006; Johnsen 2012 et al.; Johnsen et al., 2025) The concepts on emulation were derived from ideas in the education literature on “complex thought processes” – interpreted to reflect critical thinking. A synthesis of ideas into a prototype or explicit learning guide for critical thinking was initially absent at that time. A basic premise is that a designated thought process or act of reflection is the learning outcome, the learning guide, and the assessment instrument. The goal is to guide what the student is to demonstrate in their thought processes. The designated thought process is derived from scholars or experts succinctly enough for the novice to apply to a life experience. With no reference point for a “perfect” thought process, the designated thought process or reflection guide is inherently imperfect initially with continual adjustments.

Following concepts in experiential learning, Life Design 2.0 offers a rich experience in self-reflection that will be invaluable after graduation and is not explicitly offered elsewhere in the University. One goal is to instill lifelong creativity by mastering a skillset in reflection for lifelong use. Since almost all situations encountered in life are different from the ideal situation, analysis and reflection are tools for adaptation to unfolding life situations. Helping students to adapt to life situations requires a general skillset that can be adjusted as nuances arise. Although the concepts applied in this exercise are contemporary, they can be traced back to philosopher David Hume: Thinking starts with doubt, reflection is at the heart of scholarship, and one’s ethics come more from feelings than reasoning. (Hume, 2007, Wright, 2009) Incorporating reflection and self-explanation prompts into instruction has been shown to improve student problem-solving according to Singer et al. (Singer et al., 2012): “Students have attitudes, beliefs, and expectations about learning that can influence their behavior and performance in courses. In addition, differences in metacognitive ability translate into differences in students’ learning outcomes. Students who are more metacognitive are better students overall.”

The domain for reflections is critical thinking: Critical thinking is the art of analyzing one’s thought process with the intent of improving it. (Paul and Elder, 2006; Bacon, 1985) Student reflection is inherently introspective with the intent of internalizing and improving the skill of reflection. The learning outcome is the thought process of reflection on one’s creativity here applied to life situations – an act of reflecting. Reflections and escalating reflections for targeted questions on life and creativity are goals for enhancing confidence on one’s creativity. The designated thought process of reflection is the learning guide. Assessment is an extension of the learning outcome, meaning Mastery/Internalization for the skill of reflecting applied to life and creativity. In addition, nuance exploration is an act of the expert. Consolidation of specific assessment questions: 1) Did the student reflect on the theme of the question? and 2) Did the student escalate the reflection accompanying escalating questions to explore nuances on a theme? Literature is sparse on learning outcomes for critical thinking skills through reflection and sparser on outcomes-based assessment of critical thinking. (Aston 24, Johnsen et al., 25) One core idea can be traced back to the ancient Greeks, “Know thyself”.
(https://en.wikipedia.org/wiki/Thales_of_Miletus, accessed 4-22-25)

Early habits in meaningful reflection on life give a maturing person a skill for life. Guiding the reflection toward fulfilling a person's confidence in their creativity increases the power of the reflection skill. Efforts are evolving to give students intellectual freedom to begin reflecting on their life's direction. The present course for this project began in 2010 with the name, "Life Design". The course has had the mission of personal introspection without a vocational component. Designs have been reported on the structure of programs to guide students toward reflecting on their futures as well as to convert reflections in finding a vocation. <https://online.stanford.edu/professional-education/creativity-and-design-thinking>

Little is reported on using explicit critical thinking learning outcomes to escalate reflection guidance to enhance creativity confidence. Similarly, little has been reported on learning outcomes and their assessment for reflections associated with enhancing creativity confidence. For this long-standing program, the current project is more about analyzing the thought processes of faculty and students eliciting reflection on one's creativity than about proactively conceptualizing designated thought processes. A challenge for analyzing this rich experience for students is that much of the methodology was developed first and analyzed after the fact.

A central premise for this project is that a learning outcome is the thought process of reflection on one's creativity here applied to life situations. The specific **Purposes** of this project are to 1) offer narratives that engage students in thematic life situations potentially familiar to anyone and take students out of the context of any academic discipline; 2) offer learning guides for thematic situations designed to elicit reflection on a life theme; narratives are intended to release student thought and emotion leading to escalating reflections on creativity; escalating reflections on creativity are presumed to increase confidence in one's creativity; 3) report learning outcomes applying reflections on the person's creativity in a life situation which then become the assessment instrument; 4) report cumulative results of student performance using escalating reflections in a Life Design 2.0 course.

Methods

The project is research more in the Darwinian model with extensive observations over time leading to alternatives rather than a model with a hypothesis testing the impact of an intervention for two groups leading to an answer. The project is research and was deemed not to involve human subjects research since no experimentation is done with students. XXXX Institutional Review Board statement: "The application #202412231 *does not* meet the regulatory definition of human subjects research and does not require review by the IRB." The authors report there are no competing interests to declare.

The design of the course calls on the student to reflect on an array of life circumstances. An overall goal is to develop skills of observation using reflection as a means of developing these skills. The learning outcome is the thought process of reflection – a lifetime skillset. The learning guide calls for response to each assigned reflection, reflections associated with the question, with follow-up reflections adding depth/escalation to the original reflection. After an introduction, each week has a different life theme, each designed with four components: A narrative engaging the student in thematic life situations; next is

a learning guide theme with questions eliciting reflections for the week's theme; next the student reflects on the questions in a designated format; last, student performance is assessed for Mastery/Internalization of the reflection and on escalation of reflections where called for. (Fig. 1)

For example, in Week 1, the **Narrative** is:

In the *Observation Deck*, Naomi Epel describes how actor Danny Glover dedicates every theatrical performance to someone. It could be a person close and beloved, or a stranger whose hardship keeps him up at night. Regardless, Glover is always laboring for somebody other than himself. This commitment can be a powerful source of strength when challenges arise and willpower wanes. It also gives his acting a deeper purpose.

To heighten the experience of this class, dedicate your Life Design coursework to someone.

Reflect on:

- Who did you choose and why?
- What thought process did you use to pick someone?
- What actions does this person inspire?
- What strategies can you apply to keep your dedication top of mind?

The same format extends for eight weeks: narrative, followed by thematic questions, followed by student reflections, followed by assessment.

The **Learning Guide** Life Theme questions eliciting reflections for the eight weeks are:

- Dedicate your Life Design to someone. Who did you choose and why?
- 5–7 most important moments in your life?
- Fifty-word memoir to twenty words to six words
- Nate's List of 15 actions
- 5–7 new things you'd like to try?
- Situation you made better with action you took? Why and how did it make you feel?
- An issue you care deeply about selecting an art medium to express concerns.
- Frame your life. What would your last sentence be? Why? How do you move forward?

The variety/array is consistent with the concept to engage the student in multiple experiences calling on reflection in critical thinking with the more such experiences, the easier to adapt to the next experience. While the above list has a main theme for each week, a call occurs each week for escalating reflections on the main theme, thus multiplying the number of reflections with a total of 40 reflections called for with each student during the course. The more such experiences, the easier to adapt to the next life experience after the course.

Performance Outcomes

Conceptualizing and reflecting on the next life encounter as developed for this project is an application of an emulation model for critical thinking. Two main activities in analyzing the course are to track patterns of student reflections and analyze patterns of learning and reflecting. Students entered reflections as responses to questions. While we were not sure of the exact responses, the anticipation was that patterns of responses would emerge. Thus, no categorization of responses was done until sample responses for five of the eight weeks were received. While the primary goal of the project was to engage the student in reflection on life and creativity, and while quantification of written responses has limitations, responses were categorized and quantified to gain insight into collective student reflections for each question and to gain insights on improving the exercise.

Students submitted reflections for each of the eight weeks with each week having a different theme. For each week four course personnel collectively reviewed a sample of entries for students 1 through 10. For each sequential week, a different ten students were sampled for a total of 80 students sampled to determine categories for student reflections. Categories of student entries were determined by consensus for each week. Three course personnel then separately reviewed entries for ten students each week; one course personnel reviewed reflections for students 1 through 10; a second course personnel member reviewed reflections for students 11 through 20; and a third course personnel member reviewed reflections for students 21 through 30 for a sample of 30 students for each week. For each week, a different thirty students were sampled for a total of 240 students sampled. The course personnel recorded the number of reflections for each of the designated categories for each week. Each row in the table represents ten students. Each thematic week could have multiple entries for each student; thus, most rows add up to more than ten.

Assessment follows an emulation model with two stages in the assessment: 1) Did the student reflect on the life question asked? 2) In cases where escalation on a topic was called for, did the student escalate their reflections? The Course Director then make an overall judgment of mastery interpreted as internalization of a process of reflection. The course director read all the reflections. In addition to the formal assessment of mastery/internalization, the course director looked for the degree of depth (escalation) for the respective reflection or set of reflections.

Components for assessment:

Overall Mastery/Internalization of the set of reflections:

- Responded to each assigned reflection
- Reflection associated with the question
- Follow-up reflections add depth/escalation to the original reflection

Since there are rarely “right” responses, students are given broad latitude to choose their reflection. Assessment is rigorous for completion of each exercise. With broad latitude on reflection/response,

assessment is accommodating on the content of the reflection/response as long as the reflection/response is associated with the question. For the one faculty member formally doing the assessments, the major focus is on “follow-up reflections adding depth/escalation to the original reflection”.

A key component of assessment is personal engagement with students by the course director. The course director has regular office hours with multiple students signing up, mostly to enhance the course experience. Of the 300 students, about ten students per week are judged for follow-up with written comments about expected depth or escalation of their reflection. The exchange starts with a look for moments of affirmation, seeking seeds for a vision of their life – for example, seeking reasons for the student to take the course whose core is about skills for reflection about life. One scenario is about looking for vulnerabilities in the person, identifying challenges to deal with those vulnerabilities, and developing a map to deal with challenges. For extreme cases – about two to three a semester – resources are sought. The course is not a counseling service. Students who complete all the exercises by demonstrating internalization of the skill of reflection to enhance creativity in life’s situations receive credit for the course. The large majority received credit based on the initial submissions and a few gained credit with remediation.

The assessment model is an extension of the learning outcome in that assessments associate with the learning outcome which is reflection and is not a separate activity not associated with the learning outcome as, for example, pass/fail would be. The assessment has been reported for other critical thinking exercises. (Johnsen et al., 2009; Marshall et al., 2011; Guzman et al., 2014; Marchini et al., 2017; Leary et al., 2019; Marshall et al., 2018; Johnsen et al., 2020; Holloway et al., 2021; Johnsen et al., 2024) Concepts for assessment in the present project parallel concepts for assessment of Emotional Intelligence: “...validity of various measures...considered relevant for defining EI should reflect a mental performance rather than preferred ways of behaving ...should be behaviorally observable, related to life and job outcomes...need for a link to outcomes.... predicting real life outcomes is an important part of the standard against which we should judge an intelligence...” (Boyatzis, 2018)

Student Feedback: One kind of feedback used eight questions with choices; statements were followed by “Strongly Agree/Agree/Disagree/ Strongly Disagree. Sample questions: “My personal story is an opportunity for learning.” and “Self-reflection can help me improve my life.” Open-ended feedback used the question: How would you describe the Life Design 2.0 course to someone else?

Results

Student reflections were robust in addressing questions with no two of 1500 reflections being identical in eight weeks. Each week just under 100% of students completed reflections on time. There was no letup in response rate through week 8. Seven of the eight weeks called for open-ended reflections. Of the 300 students who started the course, fewer than 5 (2%) dropped out. Over 280 (93%) received credit for the course. The remainder transferred to the next course offering. The course director and three course

assistants reviewed a sample of ten reflections through five weeks. The group categorized the sampling of reflections to use in determining patterns for reflections for each week.

Caption for Fig. 1: Life Design 2.0 Schematic as an overview of the course: The learning outcome is the reflection on one's creativity applied to life situations – the learning outcome is a thought process. The Course is a series of life-based reflections leading to a life-long skill. The skillset for life is the ability to reflect on multiple encounters with life. Each activity is a continuation of the learning outcome. The methodology is (in sequence) Narrative Engaging the Student in Life Situations; Reflection-Eliciting Learning Guide (Questions); Performance Outcomes in the form of Reflections; Outcomes- based Assessment; and Open-ended Feedback reflecting internalization of the learning outcome. Patterns of reflections (highlighted) were distinct for each of the eight weeks with each week having reflection patterns collectively different from any other week. The first three activities (Narrative, Learning Guide, and the Act of Reflection) are different for each of the eight weeks. The assessment is a continuation of the learning outcome and is the same for each of the eight weeks: Did the student reflect on the question and did the student escalate on their reflection based on questions calling for escalation? The variety of themes follows the concept to engage the student in multiple experiences reflecting critical thinking with the more such experiences, the easier to adapt to the next one – including situations after the course is over. An additional concept for the course is that the whole of cognitive, moral, and emotional development can be summarized by the breadth of perspectives the person can take. (David Lohman)

Three to five descriptors were agreed to for each of the reflections for a given week. No two of the twenty descriptors were identical. Categories for student reflections were developed first by having four of the authors/course personnel collectively develop categories from a sampling of ten reflections for each week through week five. Most categories were expeditiously decided with a small number seeming initially ambiguous. Categories for reflections for each week were arrived at in a single session. (Table 1, Fig. 1) Categories for each week were deemed to be a manageable number. Over-arching categories with sub-categories were designated where the authors agreed on natural groupings.

Caption for Table 1

Patterns for student reflections for each week. Categories were derived from the consensus of samplings by four personnel overseeing the course. Each week thirty different students were sampled for a total of 240 students sampled. Each week, three course personnel categorized reflections for ten students; each row represents ten students. Almost all reflections (over 90%) fit a designated category. The patterns for student reflections are different for each of the eight weeks, fitting one goal of reflecting on a variety of life situations.

Week 1: Someone: Who? Why? (Multiple entries)			
Reviewer	Determination	Empathy	Fulfillment/Purpose
#1	6	9	7
#2	4	5	5
#3	7	6	3
Week 2: Most important moments in your life? (Multiple entries)			
Reviewer	Tragedy / Success	Relationships	Transition
#1	15 / 16	15	13
#2	6 / 7	5	9
#3	4 / 4	8	7
Week 3: Fifty-word memoir to twenty words to Six Words (Multiple entries)			
Reviewer	Emotional Turmoil	Hope / Growth	Peace / Contentment
#1	8	1 / 6	5
#2	6	8 / 8	6
#3	3	4 / 7	6
Week 4: Nate's list: rewrite 50-word memoir. Record Categories			
Reviewer	Make it Weirder	Single Moment	Embrace the Chaos
#1	5	4	1
#2	4	2	4
#3	2	1	3
Week 5: 5–7 new things I'd like to try (multiple entries)			
Reviewer	Community / Shared Experience	Physical Activity	Arts & Crafts / Food
#1	3 / 7	11	15 / 6
#2	- / 6	5	5 / 2
#3	7 / 8	9	1 / 5
Week 6: A situation you made better; the action you took and why? How did it make you feel? (Multiple entries)			
Reviewer	Helping / Acts of Service	Relationships	Community

Week 1: Someone: Who? Why? (Multiple entries)			
#1	5	5	0
#2	12	10	9
#3	5	8	2
Week 7: An issue you care deeply about; make a work of art expressing concerns. (Multiple entries)			
Reviewer	Themes: Inequalities / Mental Health Stigma		
#1	46		
#2	74		
#3	71		
Week 8: Frame your life: What would your last sentence be? Why?			
How will you move your life forward? (Multiple entries)			
Reviewer	Living Unapologetically	Sense of Self	Role Model / Specific Experience
#1	9	1	7
#2	10	10	11
#3	8	8	7

A common situation was where one person used one word, and another person used a synonym resulting in reconciliation to one of the synonyms. There were no instances where a category from one question was confused with a category from another question. Of the 28 descriptors, two were found in two different weeks where themes were observed: "Community" appeared in Weeks 5 and 6 and "Relationships" appeared in Weeks 2 and 6. The other twenty-four descriptors were unique one from another. Groupings of descriptors for each week were separate and distinct. Students entered 155 items for the first five weeks, with most responses having multiple entries. One course personnel applied the designated categories for each week as a corroboration of the designated categories. Of the 155 entries through Week 5, the one course personnel classified 142 into a category for that respective week with 9 judged to have no clear classification for a classification rate of 91%. Categories of student entries were determined by consensus for each week.

For the initial goal, "The design of the course calls on the student to reflect on an array of life circumstances.", a wide array of themes is generated by student reflections. Reflection themes range from almost all positive on some themes, for example, the theme on a role model in week 1, to a mix of themes of both tragedy and success in week 2 regarding most important moments in life, to emotional turmoil juxtaposed with hope and growth in week 3 with the personal memoir. The juxtapositions in the range of reflections are as wide as the number of combinations for any two weeks.

Almost all students were judged by the course director to offer a reflection associated with the question and to escalate (add depth) in follow-up reflections. The (overwhelming majority) were judged to need no guidance or to have minor guidance on the spot; a handful of the 300 students we judged to have missed the direction of the question or didn't follow the assignment. Three course personnel each read, reviewed, and gave feedback on ten reflections each week for a total of thirty reflections reviewed in more depth. Since this is an interactive process, "learning moments" are available should the faculty judge that the student is making good progress but needs additional coaching on a specific point.

Student reviews of the course

245 of 300 students completed the questions with choices from "Strongly agree" to "Strongly disagree". Responses were overwhelmingly positive. For the eight questions, 1310 of a possible 1960 (67%) gave a response of "Strongly agree". Zero gave a response of "Strongly Disagree" (of a possible 1960 opportunities). Over 240 of the 300 students offered feedback for the open-ended question, "What did you think of the course?". In a sampling of fifty consecutive student feedback entries, more than half were more than 20 words with many being more than 40 words. Forty-five of the fifty feedback entries sampled (90%) were about introspection. Twenty-two of the student feedback entries sampled used the words "reflect" or "yourself" as part of the feedback. Feedback was seen as an indication of internalization for the thought process of reflection about one's creativity which is the learning outcome.

Discussion

Concepts from the education literature and applications from the health sciences served as a prototype to develop the critical thinking learning outcome in Life Design. The emulation model for critical thinking was suitable in the Life Design context. Once the learning outcome, specifically, the designated thought process, was developed, the learning guide and assessment instrument followed. Students were engaged in using their creativity to reflect on an array of life's situations looking inward as well as outward. The course format sequence was effective in engaging students to reflect on their creativity: narrative engaging students in thematic life situations; a sequence of learning guide thematic questions; student performance recording reflections; assessment of performance on reflections associated with respective life themes; and open-ended student feedback confirming the learning outcome as the thought process of reflection. (Figure) The nearly 100% response rate for 2400 reflections is interpreted to show engagement of students in reflecting on life's situations – maybe for the first time? The continued uniform response rate is interpreted as a continued high level of engagement for students with no sign of fatigue or boredom. Students were "into it"! The array of questions led to students to reflect on a variety of life situations in different ways for an array of questions for each week. With the goal of "The design of the course calls on the student to reflect on an array of life circumstances.", the array of themes is wide. While the array of themes is not infinite, the challenge of reflecting on this array of themes and the challenge of escalating these reflections gives the student extensive practice on this life skill in a way they may never have done before. Extensive student responses support the statement

that this experience of reflecting on life situations is unique for them to this point in life as shown in Table 1.

Patterns of reflections were different for each week. No week's reflections could be confused with any other week. Students have been given a skillset for reflection on life that can be carried on through the rest of their lives. The array of topical questions calling for reflections in sequential weeks led to an array of reflections for very different kinds of life experiences. Each category for each respective week was interpreted to have an unmistakable presence for that respective week. Variation was found as to how many reflections were found for each category for each week, but only one category for one of the weeks was found to have no entries. (Week 5, second course personnel "Community") The sample of 240 students is seen as adequate to submit that respective categories are prevalent in student thinking for each of the themes/weeks. The guidance for students to reflect in the patterns described follows the weekly separate thematic narratives and the line of questions eliciting specific reflections for each theme. A further limitation is that each week had multiple responses with some sentences in reflections having the potential for more than one category of response; also, any one student could make multiple entries to give some skew to the data. Overall responses for any week would not be confused for responses for any other week. The array of reflections over the eight weeks fits one of the goals of agility in reflecting on life presentations. Assessment to a level of mastery/internalization was high.

Assessment is a continuation of the learning outcome and not a separate exercise. The finding that 90% of responses to the open-ended question, "What did you think of the course?" were about introspection is seen as an indication that students internalized the thought process of reflection about their creativity going beyond, "I liked the course". Student feedback is also seen as a continuation of the learning outcome for critical thinking from defining the outcome to guiding learning to assessing performance through to confirmation for internalization of the thought process of reflection in student feedback.

The emulation model for critical thinking was suitable to define the learning outcome, guide learning, and assess performance for students reflecting on their creativity to gain confidence in their creativity. The model was suitable for a course for 300 students. Reflection on one's creativity through escalating guidance fits the basic concepts of designating a learning outcome for critical thinking, with learning guidance and performance assessment, all as part of the same learning model.

We see this as a contribution to learning in undergraduate higher education. Results are interpreted to show that learning and skillset internalization for reflection on creativity to address life situations are happening. How that learning and internalization of the skillset for reflection is occurring is open to exploration for additional work. Literature is sparse to non-existent on learning outcomes for critical thinking, including reflection. The model is emulating the intended activity with the more direct the emulation the greater the validity. What is aspired for the student to do. The concept to engage the student in multiple experiences reflecting critical thinking with the assumption that the more experiences, the more easily the student will pick up the next one is also in play in Life Design 2.0:

Contextualizing a sequence of critical thinking exercises (students internalize a learning outcome on reflection in a designated situation) into the larger realm of undergraduate higher education

Critical thinking is widely viewed as important for success in life. Little literature exists on learning outcomes in critical thinking. The concepts from this project with an explicit example of applied critical thinking add to both the culture and methodology of higher education. This extended series of critical thinking demonstrations goes beyond a student's thinking critically and analytically on an intuitive level, by converting intuition into a conscious explicit thought process to be analyzed for improvement – an “art”. Paul and Elder, Bacon – an “art”. Criteria for critical thinking learning guidance and assessment based on reflection demonstrated here fulfill criteria for emotional intelligence (Boyatzis).

The road to the sequence of critical thinking exercises in this report is worth analyzing for future projects leading to explicit learning outcomes. First came concepts for an emulation model in the Education literature, but without applications. Next, came conversion in recent years from intuitively guided critical thinking in the health sciences (without a theoretical basis) into a critical thinking emulation model using concepts from the education literature for multiple settings/skillsets. For the current project, the task was to convert theory-based critical thinking learning outcomes and skillsets from the discipline-based health sciences to a more general life-oriented experiences in undergraduate higher education. Through the sequence of events a central theme is to use concepts in critical thinking to develop learning outcomes for life situations. We are not aware of literature on the last step and only literature in recent years for application of critical thinking concepts to the health sciences. Progress on achieving critical thinking outcomes is based on a culture of inquiry, rigor, respect and role modeling.

Possible next steps: identify a place or places where intuitive teaching and learning is strong with a supportive culture; then derive the thought process of the consensus master in a field succinctly enough to for the student to apply to the next relevant situation.

The road to implementation took multiple years. Developing a symbiotic network of critical thinking skillsets in the health sciences took over a decade and is still not widely implemented as described. Developing symbiotic networks of critical thinking skillsets based on learning outcomes in undergraduate higher education would seem to take at least that long.

Continued isolated theoretical discussions about critical thinking will not work to give students explicit skillsets in critical thinking. Reflection on one's creativity seems a worthy place to introduce an outcomes-based demonstration of critical thinking into the undergraduate experience. This is a beginning.

Conclusions

Concepts from the education literature and applications from the health sciences served as a prototype to develop the critical thinking learning outcome in life design. Critical thinking through reflection is an essential skill and an essential component for success in life. Literature Reflection for Undergraduates is

sparse on learning outcomes for critical thinking skills through reflection and sparser on outcomes-based assessment of critical thinking. The current project is more about analyzing the thought processes of faculty and students for this long-standing program eliciting reflection on one's creativity than about proactively conceptualizing the designated thought processes. The learning outcome is the frame of reference for each step in the student's progression through the course.

The thought process of reflection on one's creativity is the learning outcome

Narrative engaging students in themes for reflection

Learning guide with questions eliciting reflection

Performance outcomes: reflections of students on respective themes

Outcomes based assessment

Student feedback confirmation for internalization of the learning outcome/thought process.

Nearly all students completed each of the exercises on time with nearly all were judged to have internalized the reflection for each weekly theme. This contribution to the higher education literature offers a model for defining the learning outcome for critical thinking. The model can serve as an example for learning guidance, and outcomes-based assessment. Confirmation comes from student internalization of the learning outcomes reflecting on one's creativity and from student entries on open ended feedback.

Declarations

Ethics/consent: The project was deemed not to involve human subjects research since no experimentation is done with students. The University of Iowa Health Institutional Review Board statement: "The application #202412231 does not meet the regulatory definition of human subjects research and does not require review by the IRB." The authors report there are no competing interests to declare. The teaching program had been operational for many years; no adjustments were made in the teaching approach for this project. People analyzing data did not have access to student names or any identifying information. The project is more in the Darwinian model with extensive observations over time leading to alternatives rather than a model with a hypothesis testing the impact of an intervention for two groups leading to an answer. This study analyzed survey data that had already been completed separately in the normal operations of the teaching program.

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There was no external funding for the project.

Author Contribution

Authors contributions: • David L Gould led the Life Design Program for over a decade. • David L Gould, David C Johnsen, and Nichols Colangelo converted the thought processes of the life design program leader into a critical thinking learning outcome for application to undergraduate students. The designated thought process was used to define the learning outcome, guide learning and assess performance as an extension of the learning outcome. • Maia McMean and Kate E Farnum reviewed student reports for 300 students for eight weeks. • David L Gould, David C Johnsen, Maia McLean, and Kate E Farnum categorized deidentified student responses appearing in Figure 1 and Table 1.

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Institutional review board statement

The project is research and was deemed not to involve human subjects research since no experimentation is done with students. XXXX Institutional Review Board statement: “The application #202412231 *does not* meet the regulatory definition of human subjects research and does not require review by the IRB.”

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Figures

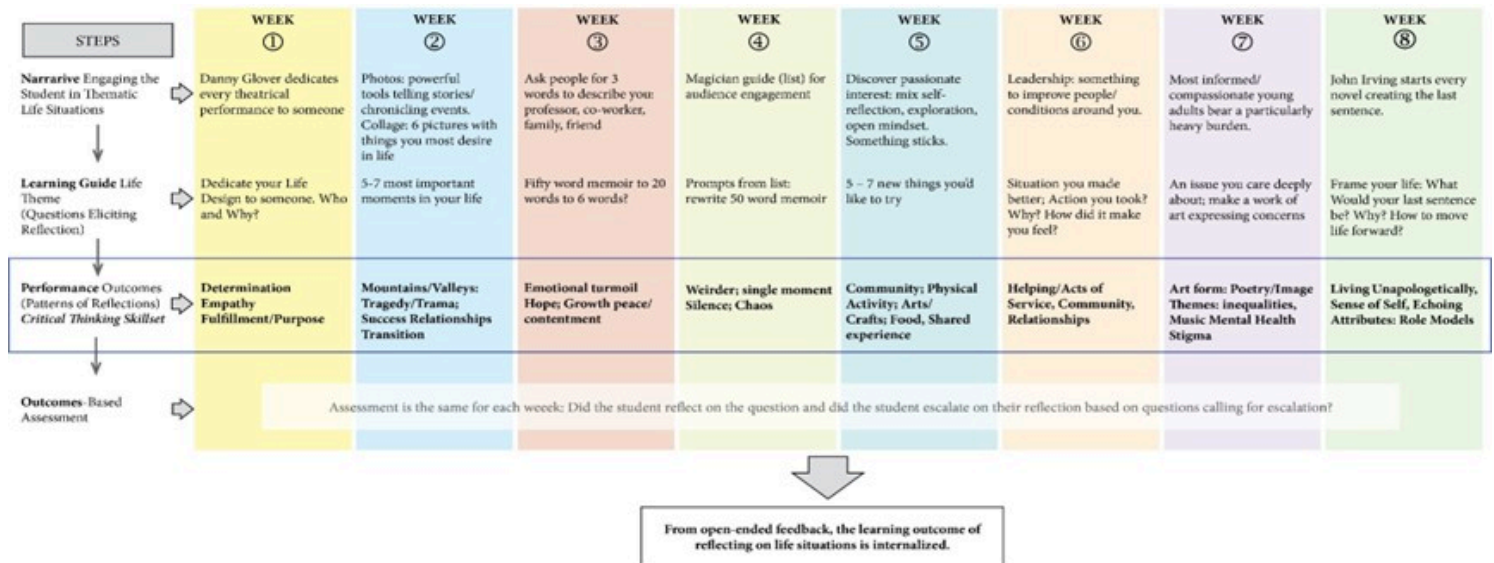


Figure 1

Caption for Figure 1: Life Design 2.0 Schematic as an overview of the course: The learning outcome is the reflection on one's creativity applied to life situations – the learning outcome is a thought process. The Course is a series of life-based reflections leading to a life-long skill. The skillset for life is the ability to reflect on multiple encounters with life. Each activity is a continuation of the learning outcome. The methodology is (in sequence) Narrative Engaging the Student in Life Situations; Reflection-Eliciting Learning Guide (Questions); Performance Outcomes in the form of Reflections; Outcomes- based Assessment; and Open-ended Feedback reflecting internalization of the learning outcome. Patterns of reflections (highlighted) were distinct for each of the eight weeks with each week having reflection patterns collectively different from any other week. The first three activities (Narrative, Learning Guide, and the Act of Reflection) are different for each of the eight weeks. The assessment is a continuation of the learning outcome and is the same for each of the eight weeks: Did the student reflect on the question and did the student escalate on their reflection based on questions calling for escalation? The variety of themes follows the concept to engage the student in multiple experiences reflecting critical thinking with the more such experiences, the easier to adapt to the next one – including situations after the course is over. An additional concept for the course is that the whole of cognitive, moral, and emotional development can be summarized by the breadth of perspectives the person can take. (David Lohman)