Cultivating Higher Order Thinking Dispositions of Undergraduate Students

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Abstract—This paper discusses the conceptualization and experimental stage of a longitudinal study that seeks to design and evaluate a training program to cultivate, amongst Singaporean university undergraduates, the disposition to make sense of novel situations and unfamiliar information competently and spontaneously. This process is guided by the "thinking dispositions" perspective that treats teaching as the process of enculturation. This stage of the study focuses on enculturation instructions, which comprises "thinking routines" that are used to make thinking "visible" and henceforth scaffold the learning process. The thinking routines used in this study are fashioned after "thinking moves" that constitute certain Higher Order Thinking skills that this study's target population lack, namely, "analyze" and "create". Further research needs to be conducted to construct a reliable method of assessing the performance of respondents in order to explore the relevance of the "Visible Thinking" framework to andragogy.

Index Terms—thinking dispositions, visible thinking, thinking routines, higher order thinking skills, Bloom's taxonomy, andragogy

I. INTRODUCTION

This paper presents the early conceptualization and experimental stage of a longitudinal study of Singaporean undergraduate students' thinking dispositions. It aims to design and evaluate a training program to cultivate the disposition to make sense of novel situations and unfamiliar information competently and spontaneously. The central focus of this stage is the fashioning and testing of "Thinking Routines" for teaching certain "thinking dispositions" to adult learners. Henceforth, a large portion of the following sections documents the motives behind this research and its theoretical underpinnings. This would be followed by descriptions and explanations of trial constructions of classroom practices that seek to cultivate selected thinking dispositions amongst the respondents of this study.

The study was motivated by two observations. First, according to The Future of Jobs report published by the World Economic Forum [1], [2], "complex problem solving", "critical thinking", and "creativity" were identified as the top three skills that employees of 2020 need to possess in order to stay relevant in the Fourth Industrial Revolution. The implication of this report on

higher education is that the speed at which old jobs become obsolete and new ones created, makes training undergraduates in narrow skill sets to meet short-term manpower needs, a risky investment. Graduates thus need to be trained in ways that prepare them to deal with an unpredictable economic climate.

Despite the need for the above-mentioned attributes, the Principal Investigator (PI) observed that his students majoring in business subjects display learning habits that indicate a lack of readiness for the Revolution. These students treat learning as the process of memorizing procedures and applying them to recycled case studies. As a result, they struggle with courses that do not provide model answer templates and that offer a wide range of empirical test-beds. They also treat research as mere observation and documentation, which is reflected in assignments that often contain descriptions devoid of any attempts at making sense of primary data.

These behaviors suggest that students are habitualized towards the acts of remembering and applying, but not ways of dealing with new information and novel situation in the form of constructing conspiracy theories in a course on philosophy, to composing a satire on marriage in a course on literature. It appears that what these students require, are better training in Higher Order Thinking skills (HOTs): cognitive processes that are activated in the face of complexity, unfamiliarity, and uncertainty.

II. THINKING DISPOSITIONS

The teaching of critical thinking remains a contentious issue due to the lack of consensus on its definition, assessment methods, level of generality and specificity, and amount of impact on students' career and other domains of life. Despite the debates, surveys conducted with institutes of higher learning (IHLs) around the world show that "critical thinking/complex problem-solving" remains one of the core learning outcomes of university education, and are skills that are in demand from employers [3].

Singaporean IHLs also offer training, some of which are compulsory, on critical thinking or its equivalence, as part of their foundation or general elective courses. Examples include "Analytical Skills & Creative Thinking", "Effective Reasoning", and "Logic and Critical Thinking". These courses resemble one another in that they do not aim to transmit content knowledge, but to provide "thinking tools" to learners through teaching

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"formal methods" that includes deduction, systems thinking, design thinking, etc.

The "formal methods" approach is one of the four major perspectives on thinking. The rest are namely, the "heuristic methods", "intelligence", and "dispositions" perspectives. The heuristic methods perspective treats effective thinking as the application of both factual and procedural knowledge. The "intelligence" perspective treats "good thinking" as the product of underlying intellectual ability. Finally, the "dispositions" perspective goes beyond ability to include inclination and sensitivity as prerequisites.

The formal methods perspective has increasingly fallen out of favor because its learning outcomes play a limited role in everyday thought [4]. The heuristic methods perspective is a content-intensive approach that focuses on transmitting "tricks of the trade" [5]. This suggests that it teaches skills that are superficial and could become obsolete in the future because they are too closely tied to specific professions or tasks. The intelligence and dispositions perspectives seem to bear the most potential for their practical implications for students' performance in a world characterized by greater complexity, unfamiliarity, and uncertainty. This is because what they seek to teach are neither too procedural like the formal methods approach nor too content-heavy like the heuristic methods approach, granting the attributes that are cultivated a higher level of portability without compromising on practicality.

Research conducted at the Harvard Graduate School of Education has shown, however, that unlike what is assumed in the "intelligence" perspective, being a "good thinker" does not only require thinking abilities but also the inclination to think, and the sensitivity to the occasions and objects of thought [6], [7]. Further exploration into how dispositions could be taught and assessed gave birth to the Visible Thinking (VT) framework famous for its utilization of "Thinking Routine" (TR).

The VT framework shares many similarities with cognitive apprenticeship. These include the argument that thinking should be made visible, and that learning should be scaffolded [8]. Perhaps the greatest overlap between the two is their critiques of formal educational models that tend to treat the learning process as one of "transmission". This model may be good for cultivating abilities, but is "ill-equipped to teach for commitment to principles and conducts (inclination) and alertness to appropriate occasions for their deployment (sensitivity)" [9]. The cultivation of inclination and sensitivity requires an "enculturation" model that treats learning as a process of immersing within what anthropologists of apprenticeship call a "community of practice" [10].

All enculturation involves three mutually-reinforcing processes that occur within a community of practice: cultural exemplars, interactions, and direct instructions. Exemplars of thinking dispositions can take the form of artifacts or instructors that embody those dispositions, like well-written articles or the instructors' clear articulation of thinking processes. Interactions between instructors and students must involve activities that add meaning to the dispositions being taught, like working on projects that requires collective expression of those dispositions. Finally, dispositions to be taught must be explicitly articulated by instructors, i.e. they must be made "visible".

In trying to adopt the enculturation model, this study encountered many institutional obstacles in establishing a "community of thinkers". These include the lack of common spaces for communal activities, and common free periods within students' busy schedules for them to interact. This study thus focuses on incorporating the three enculturation processes in its series of pilot training workshops. At its current stage, the emphasis is on constructing and implementing TRs that are used to make specific thinking moves visible.

III. ANALYZE AND CREATE

Through teaching a course on social research, the PI observed how students' performances in class discussions, post-class consultations, and written assignments reveal deficiencies in certain thinking dispositions. In this course, students formed groups of five and each group was allocated a topic on which they were required to formulate a research proposal, collect data, analyze their findings, and submit a final report. These topics represent pertinent social issues that Singaporean society encounters, from "immigration and population" to "politics and social media".

Every proposal formulation process, practiced during class discussions and consultations, required students to answer basic questions about the object of their research and the variables they intended to test. Despite having read instructional texts, passed online quizzes, and drilled on these questions through face-to-face practice, students still found difficulties trying to identify the social phenomenon within the given topic that they would like to observe, and to construct and differentiate between dependent and independent variables.

Students often failed to distinguish the hypothesis they were trying to test from the object of their observation. For instance, instead of "racist conduct", students would argue that "how the occupation of respondents increases their level of racism" was the "thing" that they were trying to observe. They also failed to see the differences between indicators and variables, often calling "income level" a variable instead of what it indicates: "spending power/socio-economic status". This suggests that students struggled to differentiate between components of research, recognize their inter-relations, and link them to the larger purpose of their research.

In their final report, students were required to analyze and explain their findings. However, they often ended up documenting their observations and classifying them using methodological rather than analytical categories. For instance, a majority of reports contained descriptions and examples of responses from interviewees, organized using headings like "interviews", "surveys", and "respondents", instead of concepts like "ideologies", "gender", or "class". Instead of using these concepts to categorize and explain their findings by relating the object of their observations to larger social structures, students habitually reduced all human behaviors to individual choices. This suggests an inability to categorize information and construct relationships between *explanans* and *explandum* in novel manners.

IV. METHODS

Although Bloom's taxonomy has been criticized for placing cognitive processes in a hierarchical relationship [11], what it offers are terms for articulating what "thinking" entails, and henceforth the explicit "thinking moves" after which TRs could be fashioned. According to its revised version [12], the cognitive dimension includes remember, understand, apply, analyze, evaluate, and create.

Amongst the six, the processes of "remember" and "apply" describes what the PI's students are predisposed to perform, while "analyze" and "create" appears to be what they struggle with. "Analyze" is defined as "breaking material into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose", and "create" as "putting elements together to form a novel, coherent whole or make an original product".

The constituents of "analyze" and "create" further provide concrete thinking moves for constructing TRs. "Analyze" is broken down into three parts: differentiating, organizing, attributing, and "create" into generating, planning, producing. Unlike the constituents of "analyze", those of "create" are much more ambiguously defined; alternative terms like hypothesizing, designing, and constructing are comparatively easier to work with.

Even though TRs have mostly been used for teaching K-12 students and have shown promising results [13], [14], the assumptions behind their utilization, that good thinking includes ability, inclination, and sensitivity, does not exclude their possible efficacy for teaching adults. In fact, one study on adult learners has shown that TRs do improve clinical reasoning amongst students, and helps educators better articulate tacit knowledge [15]. If indeed the practice of TRs cultivates dispositions like "capturing the essence of an event, idea, concept, and topic" and "making connections" amongst children [16], they could also be used to nurture similar dispositions towards "breaking material into its constituent parts" or "putting elements together to make an original product" within undergraduate students.

To test the above hypothesis, the primary method employed at the early stages of this study involves fashioning TRs after specific "thinking moves" described in Bloom's categories of "analyze" and "create", and testing them with 15-20 participants in a series of pilot workshops over a period of three months. The TRs were implemented in no particular order, over 12 weekly twohour sessions. Students formed groups of 4-5 members and worked together to practice the TRs under the guidance of the PI. The Co-PI serves as an observer and gathers feedback, at the end of the fifth and tenth sessions, from the students.

V. THINKING ROUTINES

Harvard Graduate School of Education's Visible Thinking project came up with a list of seven core TRs that was later expanded to include 11 more. Each TR is accompanied by a short commentary that describes what kind of thinking the TR encourages (purpose), where and when it can be used (application), and tips for starting and using the TR (launch) [17]. Popular TRs include See/Think/Wonder that gets students to answer three questions after being exposed to pieces of art: "What do you see?", "What do you think about that? and " What does it make you wonder?"

Using these TRs and their commentaries as a guide, the PI constructed the following list of TRs. Those that make "analyze" visible are as follows:

A. Distinguish, Categorize

This TR gets students to distinguish between two items, and then categorize new items using the criteria they have created. The purpose is to cultivate inclinations towards identifying and explicating the criteria that differentiates objects or ideas, and towards disciplined application of their criteria to novel cases.

One of the exercises involves the discussion of the nature of "superheroes" during which the notion of "antiheroes" emerged. New characters were then offered for categorizing into the two notions, including "Godzilla", "Batman", and "Powerpuff Girls".

B. Define, Decide, Refine

This TR gets students to define a particular term, decide whether an example fits their definitions, and then refine their definitions. This TR builds upon the preceding one in cultivating sensitivity towards how new observations contribute to the refinement of existing categories.

One of the exercises involves defining the concepts of "art" and "artist". Students were then shown a promotional video of a self-proclaimed YouTube star and were then asked to decide whether the character qualifies as an artist. They would have to then refine their definitions should they find that certain qualities of the character were not captured by their criteria.

C. List, Unravel

This TR gets students to list ways of expressing a certain idea, and then unravel the layers of meaning behind those expressions that allows the latter to covey the idea. The purpose is to cultivate inclinations to move beyond attending to the literal meanings of symbols, towards the habit of identifying and articulating the exact messages carried in their connotations.

One of the exercises involves getting students to list the various metaphors that express the idea of "love", and then articulate the implied meanings of these metaphors. Metaphors that were discussed include "fall in love" that implies "a loss of control over oneself", "you break my heart" that implies "the fragility of one's feelings", and "light up my life" that implies "the central role of sight in human perception". The TRs that make "analyze" and "create" visible include:

D. Define, Alter

This TR gets students to define a particular term, followed by altering an item that defies their definitions in such a way that it ends up satisfying their definitions. The purpose of this TR is to "uninstall" students' inclination towards taking opposing ideas for granted, so that they could actively dismantle artificial bifurcations and hence create possible connections between the ideas.

One of the exercises involves defining "cuteness", and one major criterion that students came up with was "imperfection". Students were then asked to alter "God", a supposedly perfect being, into something that is possibly "cute".

E. Identify, Remove, Recreate

This TR gets students to identify the components that constitute a particular item, remove what they consider to be the primary component of the item, and then create a new item out of the remaining components. The purpose of this TR is to cultivate inclinations towards paying attention to the core characteristics of objects, sensitivity towards how constituents relate to constitution, and the ability to tweak components to create a new product.

An example of this exercise uses the item "western medicine". The students identified "germ theory" as the primary component, which on removal compelled them to design novel forms of medicines. These include those that resemble traditional ethnomedicines of India and China, spiritual forms of healing, and a futuristic therapy that harnesses gravity.

F. Alter, Solve

This TR gets students to alter a specific prescriptive system so that they could use it to solve a problem that the original system was not designed for. The purpose of this TR is to cultivate the ability to construct possible connections between seemingly unrelated or opposing ideas, through the act of solving a problem.

An example of this exercise requires students to refine "horoscopes" to deal with "dengue fever". Students redesigned horoscopes through introducing "bridging concepts" like "electro-magnetism" and "spiritual energy" that were employed to control the behaviors of the virus, the mosquitoes, or human carriers.

VI. LIMITATIONS AND IMPROVEMENTS

Given that this study is still in its early stages, many issues remain unexplored. The primary problems that the thinking dispositions approach encounters are that dispositions take a long time to cultivate, and are hard to assess. Given that this study would be funded for three years, there may be sufficient time for effects to surface. However, whether or not the dispositions were actually cultivated depends on the methods of measuring them.

At its current stage, this study has yet to complete constructing the assessment methods, a task to be completed by the Co-PI who adopts a backwards-design approach [18]. The PI thus has to rely on the students' feedback as a proxy to evaluating the utility of the TRs. Students' comments were mostly concerned with how "engaging" the topics were, which remains an important issue because the success of the study depends on students' regular attendance. All participants, however, agreed that they find the TRs "meaningful", because their purposes were well-articulated, and that the instructor was "open-minded" enough to help them engage in polishing ideas that they deem "amateurish". The most significant feedback was provided by six students who reported that they have observed certain transformations in what they called their "thinking habits". They are:

- Greater sensitivity to ontological issues. These students noticed that, through regular engagement in the thinking moves of identifying, distinguishing, defining, they have developed the habit of "looking for the essence of a thing" as the first step towards any analytical attempt.
- Greater flexibility. These students noticed that, through regular practice of bridging opposing items, they have developed the attitude of not dismissing possible relationships between seemingly unrelated ideas, and experienced a greater inclination towards coming up with "creative associations".

The above feedback may not reveal, in a reliable manner, the efficacy of the TRs, but they provide a rough idea of how the design of the pilot workshops shapes the participants' learning experiences, specifically the roles of exemplars and interactions. Therefore, in addition to assessment, this study also requires further thinking and design of the enculturation processes. In its current form, the PI as the instructor of the workshop serves as the exemplar through articulating what "analyze" and "create" entails, the thinking "moves" that TRs make visible, and through embodying these thinking dispositions in his facilitation of the workshops. Other forms of exemplars like writings, paintings, or sculptures could be incorporated into the future. The interactions between students currently take the form of group work, through which they collaborate in administering the TRs on specific items. Other types of enculturation interactions like role-playing, debates, and skits could be incorporated in the future.

The above possibilities could be incorporated together with suggestions from the Co-PI. The primary observation that the Co-PI made was that the activities of the workshop resemble an intensive "sparring" session, during which the instructor offers thinking moves, like counter examples, directed towards getting students to reciprocate with a more refined moves. This approach assumes that, through this exchange, the students would be able to observe and absorb the required dispositions. What this "combative" model needs is more scaffolding, and thus future sessions could be improved with the following adjustments:

• Intermittent pauses. The discussions occur in a pace that does not provide enough opportunities for participants to reflect on what thinking moves

they were employing, i.e. metacognition. Pauses should be included periodically to ensure that participants and instructors make the thinking moves visible to one another.

- Taking turns. Some sessions, due to the small number of participants, involve all participants in the discussions. This means that they do not have the opportunity to observe exemplars at work. In future sessions, participants could take turn to "spar" with the instructor while the others observe the thinking moves being exchanged.
- Indentifying moves. Even though each session is guided by the practice of TRs, during the discussions, several other thinking moves like the use of analogies were employed. One group of participant could be asked to observe and identify these moves, which could be used to fashion TRs for future sessions.
- Simplifying moves. Certain TRs involve several steps that cannot be covered within a two-hour session. The more complex TRs like "identify, remove, recreate" could be broken down into smaller chunks for future sessions.
- Evaluating moves. Thinking moves that have been broken down could be practiced with simpler topics, followed by discussions on how well the moves were executed.

VII. FUTURE RESEARCH

The next stage of this study involves conducting formative evaluation of the workshops. This includes the following steps:

- Learning needs assessment. This step utilizes data gathered from interviews with industry partners and students to further explore the learning needs of students. Employers' contribution could provide deeper insights into the sort of thinking dispositions that they require from their employees, on top of those that the PI observed in a classroom setting. The revelation of various thinking moves during the pilot workshops also suggests that Bloom's definitions of "analyze" and "create" are not comprehensive enough, or that they require the support of other moves for students to be proficient in them.
- Articulating assumptions and theory of change. This step seeks to better organize and clarify the relationships between how the training program is supposed to work and the assumptions behind how students are supposed to progress. It involves synchronizing measurable milestones in students' learning journeys with the configuration of the program. In its current form, the training program lacks a tracking system to gauge students' gradual improvements over time, and assumes that improvement is a natural consequence of regular practice.
- Process evaluation. This step seeks to design activities that are well-coordinated towards

practicing a specific TR and coming up with measures to ensure that instructors do not deviate from the design of the session.

• Context evaluation. This step assesses whether the content of discussion is suitable for a classroom setting in order to eradicate topics that are more suited for other contexts.

VIII. CONCLUSION

This paper presents the early stages of a three-year longitudinal study into teaching HOTs to university undergraduates. It adopts the "thinking dispositions" perspective in the design of its training program, and hence treats teaching as "enculturation". The structure of its pilot workshops incorporates the three processes of enculturation: exemplars, interactions and instructions. Special emphasis is placed on instruction that takes the form of TRs that make the moves of analyzing and creating visible. The next step of this study involves improving the scaffolding of participants' learning, employing other enculturation exemplars and instructions, and formative evaluation of the workshops so as to further explore the relevance of the Visible Thinking framework to andragogy.

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