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AN ADAPTED ETHNOGRAPHIC APPROACH TO SOCIAL COGNITION AND COGNITIVE APPRENTICESHIP IN DESIGN LEARNING EXPERIENCE

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ABSTRACT

Design is difficult to teach in traditional ways of lecturing and testing. One defined learning methodology that applies well to design education is project-based learning. In an attempt to better understand the patterns of project-based learning in different design-related programs, we studied three small groups of teachers and students at an innovative academy based out of Shanghai Institute of Visual Art, entitled De Tao Master's Academy, and compared their education style to that of subjects in regular programs at Shanghai Institute of Visual Art. Our goal was to seek patterns of cognitive apprenticeship in our subjects' education, and find out (a) if it's more effective than the traditional approach, and (b) can modelling (i.e. direct replication of learned material) be excluded from a design curriculum.

The information gathered through surveys, interviews and observation were segmented into six categories: (1) self-regulation, (2) creative thinking and thinking styles, (3) incorporation of cognitive apprenticeship model into teaching style, (4) teaching hours vs. self-learning, (5) individual vs. team work preference, and (6) learning environment and teaching resources.

We found that self-regulation was uniformly low throughout the sample, but that De Tao curriculum aimed to increase it over the course of their programs. Most students preferred small teams, with less than 5 students to do assignments and projects with, instead of individually working or working in large teams. Curriculum and interviews indicated De Tao programs had a higher focus on teaching creative thinking and independence, which reflected on design self-efficacy scores of their students when compared with SIVA students. Learning spaces at De Tao were observed to be better, and their instruction constructed close to cognitive apprenticeship. Coaching, scaffolding, articulation and exploration were evident in the design education methods adopted at De Tao. The ethnographic findings were related into an evolved social cognitive design framework, which allowed us to preliminarily contextualize design learning influencers.

Keywords: Cognitive Apprenticeship, Design education, Design Creativity, Social-cognitive theory, Interdisciplinary design

1. INTRODUCTION

1.1 Creativity for Design

Studies on design thinking and creative thinking have identified numerous factors, both individual and contextual, that affect creative performance of both individuals and teams. The Componential theory of creativity [1] states that three "within individual" components (domain relevant skills, creativity-relevant processes, and intrinsic task motivation) and one "outside individual" component (the social environment) are necessary for creative work by any individual. Studies have also shown that the underlying psychological processes (creative self-efficacy and creativity intention) completely mediate the effect of individual (motivation, personality, ability) and contextual factors (social influences from leaders and peers) on creative performance [4].

An individual's design thinking style has been found to be an important influencer on the individual's creativity and design performance. The dual process model of thinking [16] provides a framework to examine these influences, dividing cognitive processes into intuitive-heuristic based type and rational-analytical type. A dualistic theory of personality was proposed by Epstein [7] based on the dual process thinking model, called cognitive-experiential self-theory (CEST). It considers that people process information either using an analytical-rational system or an intuitive-experiential system [7]. Milojevic et Al. applied CEST to evaluate thinking styles of design students by measuring their rational and experiential thinking potentials through surveys. [11]

Learning has been described as relatively permanent change caused by an experience or action [12]. The study by Milojevic and Jin [12] is based on social cognitive learning, self-regulated learning and cognitive apprenticeship learning, analyzed in terms of social-cognitive theory (SCT) and social-cognitive learning theory (SCLT). This paper is based on these focal points and the triadic reciprocity shared by these social theories.

1.2 Social Learning Theory

The Social Learning Theory states that people acquire new patterns of behavior either through direct experience or by the observation of behaviors of others [2]. This theory developed into the Social Cognitive Theory in 1986, which considers that a person's past experiences influence reinforcements, expectancies and expectations which shape the specific response type in a person. It emphasizes the internal and external social reinforcements that influence how a person acquires and maintains behavior [10].

Within this framework, differential reinforcement is used to select those models of behavior that are considered "successful" from a pool of exploratory activities that arise due to repeated confrontations with unavoidable situations. Rewarding and punishing outcomes of actions also act as reinforcements to shape an individual's behavior. In many contextual situations, however, the outcomes of certain behaviors can be lethal and dangerous. A child cannot be taught to learn to ride a bike on a city road, for example, merely by observation or by trial-and-error methods. In these cases, it has been observed that examples serve a better purpose in learning modes of responses without including needless errors [2]. Learning through modeling is, thus, a more successful form of social learning.

1.3 Cognitive Apprenticeship Model

Traditional apprenticeship embeds the guided learning of skills and knowledge in the functional and social context of their use. Cognitive apprenticeship draws from this methodology by aiding in the guided learning of complex cognitive skills of problem solving and thinking, though by decontextualizing knowledge so that it can be used in any setting [5]. This model encompasses six teaching methods: Modeling, Coaching, Scaffolding, Articulation, Reflection and Exploration, which guides the learner through the process of conversion of the "novice" to "the expert".

There are several challenges faced when using cognitive apprenticeship for modeling learning environments as opposed to traditional apprenticeship. Firstly, in traditional apprenticeship, the task to be learnt is visible, however, in cognitive apprenticeship, efforts have to be made to make the teacher's or the expert's thinking process visible. Secondly, situated cognition is required, that is, the abstract tasks of the school curriculum or the training module (e.g. in organizations) have to be situated in contexts that are understandable to the learners. Finally, unlike traditional apprenticeship where the learners focus on tasks very specific to the skill or industry (e.g. stitching buttonholes is inherent to tailoring garments), in cognitive apprenticeship the learners have to learn to generalize the skill, learn the context in which the skill is applicable and then transfer the skill in novel situations [6].

Cognitive Apprenticeship Model has been proposed and implemented in many studies as a framework to design and improve learning experience, improve the creativity performance of individuals, and positively affect thinking styles, problem solving and creative skills. It has been used as a framework to design many different learning environments, including web-based argumentation models [17] in which students were assisted by the CAWA (Cognitive Apprenticeship Web-based Argumentation) system to improve their argumentation skills. Kidron and Kali [9] used the principles of the Cognitive Apprenticeship framework to break boundaries between levels of organizational hierarchies and aid in interdisciplinary thinking, under the wider umbrella of their BBIL (Breaking for Interdisciplinary Learning) model. Their model was found to be positively disruptive to students perceived learning experience [9]. Similarly, it has been argued that an alternative learning model for clinical skills, derived from the principles of cognitive apprenticeship and situated cognition, better prepares the increasing number of learners to face the competing demands of the nursing curriculum when compared with traditional apprenticeship learning [19].

The objective of this paper is to evaluate and examine the effectiveness of the Cognitive Apprenticeship framework when applied to design education and to analyze the effects of personal, behavioral and environmental influencers on design creativity when applied within this framework.

2. FRAMEWORK

The Social-Cognitive Framework for Design proposed by Milojevic and Jin [12], shown in Figure 1, shows the triadic relationship between the three major influencers of learning – personality, behavior and environment, and is based on the expanded social-cognitive career theory (SCCT) [14]. This paper is based on this framework, except for environmental factors -

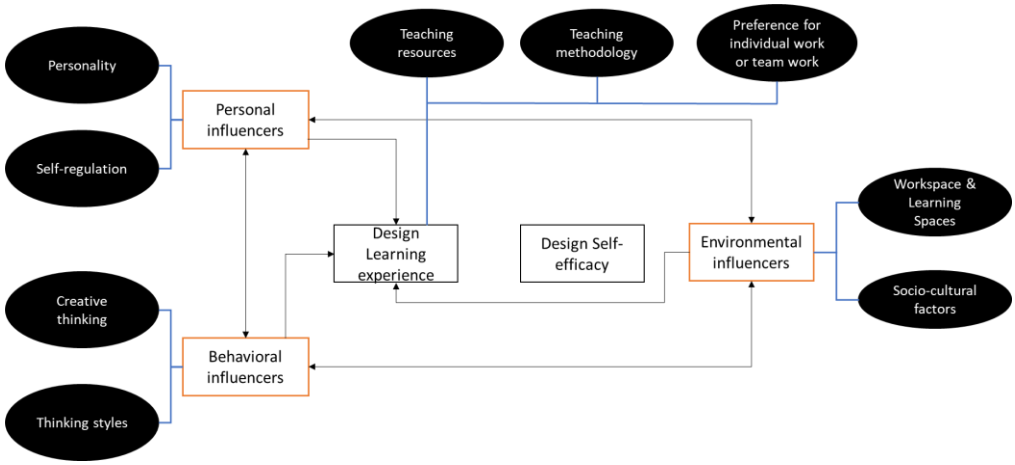

Figure 1: Relationship between influencers and factors in this study

the location factor remains the same here (China), whereas the culture and workspace are considered.

The research questions attempted to be answered through this study are hypothesized as below.

H1: Project-based learning structured within a Cognitive Apprenticeship model positively affects design self-efficacy in students when compared to traditional learning

H2: Design education requires the absence of modelling within the Cognitive apprenticeship framework.

3. METHODS

Methods of the study involved behavioral and cognitive surveys, observations and ethnographic interviews. The study was conducted in Shanghai at DTMA and SIVA over a period of 1 month. The comparison between these two institutions contrasts the social-cognitive aspects of traditional teaching to those of cognitive apprenticeship and project based learning, in design-driven fields, which are, arguably, the hardest to teach traditionally.

3.1 Subjects

85 4-year undergraduate students and 6 teachers (one from each major) affiliated to two institutional bodies - DeTao Masters Academy (DTMA, called DeTao for purposes of this paper) and Shanghai Institute of Visual Arts (SIVA), were considered for the study, in three design disciplines – Animation and Visual Arts (called Animation at both institutes), Themed Environmental Design (TED, only at DeTao), and Strategic Design and Planning (SDI, only at DeTao). The majors are typically 4 years long, with each year divided into two semesters.

The sample of 85 students who filled the questionnaire can be classified as below:

1. DTMA Sample
   - Animation: 28 students, 14 in year 3 and 14 in year 4
   - Strategic Design and Innovation (SDI): 29 students, 6 in year 2, 13 in year 3 and 10 in year 4
2. SIVA Sample
   - Animation: 14 students, all in year 2

Very few themed environment design students filled the survey questionnaire, so they have been excluded from the above sample. Data from themed environment design is gathered through student and teacher interviews.

3.2 Adapted ethnography

Ethnography has emerged as an effective method for conducting qualitative research. Methods of ethnographic research used in this study to gather data for research are participant observation, survey questionnaire and interviews [13].

Learning spaces and workspaces in both institutions were observed. Individual and small groups of students (less than 5 students), one to two groups from each major, were interviewed on personal (self-regulation, self-motivation etc.), behavioral (self-efficacy, preference of team work vs individual work etc.) and environmental (learning space environment etc.) factors. 6 teachers, 2 each from the three majors were interviewed on teaching methodologies adopted, student creative behavior and performance, and curriculum structure. A mix of ethnographic interview and structured interview practices (which we named “adapted ethnography”) was utilized, due to a small amount of time spent on-site. The field study was conducted by Milojevic, who is neither affiliated with institutions/programs studied, who had never been to China prior to the study, and does not speak Chinese. She is, however, working towards a PhD focused on design theory and methodology, which led to an interest in conducting this study. During her 1 month visit to Shanghai, she had a translator who direct-translated her spoken English to Chinese (and vice versa) as interviews and observations were

being conducted. Interviews were transcribed by Patel, who also analyzed them.

A total of 85 students filled the survey questionnaire which contained questions to probe further into these three top-level factors and enabled analysis of personality types. The following survey methods and scales were used to assess creative behavior, thinking styles and self-efficacy of students.

i) **REI**: Rational-Experiential inventory [18] is a measure of thinking preferences and assesses thinking as either rational (analytic) or experiential (intuitive).
ii) **BFI**: Big Five Personality Inventory [8] is a measure of personality and assesses personality in 5 domains - extraversion, agreeableness, neuroticism (or, if opposite, then emotional stability), conscientiousness and openness to experience.
iii) **BICB**: Biographical Inventory of Creative Behaviors [15] is a measure of behavioral creativity and assesses behavioral creativity by asking yes/no questions about the number of different, creative, habitual every-day activities that a person has been engaged in in the last 12 months.
iv) **CDQ-R**: Revised Creative Domain Questionnaire [15] is a measure of behavioral creativity by defining creative ability and considers one's the self-perception in areas where creativity is a key factor, like leadership and acting.
v) **Design Self-Efficacy** [3] is a measure of self-efficacy and assesses domain-specific confidence in performing specific tasks in the domain of design.

3.3 Interview data analysis

Interviews were conducted within the institute environment and recorded. These were then transcribed and used for further analysis as described below.

3.4 Cognitive apprenticeship model used for study

The study, including interview and survey questions, was based on six approaches of the Cognitive Apprenticeship model as described below.

i) **Modeling**: Students are shown exactly how to complete the design.
ii) **Coaching**: Students are guided, observed, and offered feedback by an instructor or an experienced designer, as they conduct design.
iii) **Scaffolding**: Students are shown what methods or strategies to use to conduct design and offered instructor's help.
iv) **Articulation**: Students are asked to think aloud in front of class or instructor, to demonstrate their knowledge of the design theory and design skills.
v) **Reflection**: Students are asked to compare their own design(s) with others.
vi) **Exploration**: Students are taught exploration strategies, then given independence to design and address their self-posed design problems.

The study focused on examining teaching methods, learning experiences and their outcomes at the institution within the Cognitive Apprenticeship framework. This study proposes a foundation for looking into cognitive apprenticeship as a tool for developing engineering design skills. While not traditionally in use, for purposes of this study, a place where a closely related model is used (DTMA) was identified and studied in relation to its origin traditional program (at SIVA).

4. RESULTS

The gathered data was analyzed and categorized under themes relevant to the Social Cognitive triad by identifying and analyzing relationships within the data, and interconnecting survey data, interview data and observational data. The following major segments were recognized.

1. Self-Regulation
2. Creative thinking and Thinking Styles
3. Incorporation of Cognitive Apprenticeship model in teaching style
4. Teaching hours vs. Self-learning
5. Individual vs. Team Work preference
6. Learning environment and teaching resources

4.1 Self-Regulation

Based on interviews with teachers and the survey questionnaire filled by students, it was concluded that the students were not very self-regulated and self-disciplined, and usually needed a 'push' to improve their performance. Teachers under all three majors did not feel that the students were self-regulated. A key cultural factor responsible for this was that, due to the Chinese education system, not very highly motivated students chose to join these majors. Some determining factors of this lack of motivation were prospects for employment and university entrance exams. According to students interviewed, arts and design appear suboptimally lucrative areas of work in China. More lucrative majors are chosen first, by those who score highly on the national university entrance exams. While there is no guarantee that higher scoring students would be more motivated, had student population had a balanced distribution of national entrance exam scores, or at least not been determined relying on this, chances are we would have eliminated this subject bias towards self-pity in both personal and educational contexts. Without feeling like one's chosen field is worth pitying, chances of students being motivated or enthusiastic might be higher.

The teaching methods and curriculum at both institutes included measures to impart more self-regulation in the students. The first few semesters (2-4 semesters) are structured to incorporate discipline, professionalism and good learning habits within the students through events, workshops, industry-relevant guest

lectures and continuous feedback and more group projects (rather than individual work). Foundational courses are given to students over the period of the first two years to incorporate habits like handling deadlines, handing in original work etc., aimed at preparing them for future opportunities in the real world on real-life projects. The themed environment design major at DeTao, for example, comprises of a Project management course in the first year. The first year comprises small projects in which students focus on stimulating their inner creativity by working on simple, abstract and, sometimes self-chosen, topics.

Most teachers felt that they saw improvement in the self-discipline and creative performance of most students in their third year, when they were assigned more individual style projects and shifted towards more creative, independent thinking. They observed that the third- and fourth-year students needed significantly lesser feedback and support from the teachers in comparison to the first- and second-year students. They also observed lesser need by the older students to get cues from the teachers to think creatively, as opposed to the younger students who needed a lot more help in this context.

Almost every student interviewed said that they were "tired" and "overwhelmed" due to a very laden coursework, including self-study hours spent on learning software or other tools, and completing assignments and projects. This may be a key factor affecting their self-regulation and needs to be further probed into.

4.2 Creative thinking and thinking styles

DeTao has a curriculum more structured towards developing creative thinking in students when compared to SIVA. The process of development of the curriculum for each major at DeTao is started by setting periodic goal statements of what a knowledge and skills a student would have attained at the end of each semester and each year. SIVA seems to be more technical in their teaching methods and curriculum. However, more collaborative classes with DeTao Advanced Classes have influenced the curriculum in SIVA Animation. There seems to exist a mutual learning and feedback relationship between the animation majors at both the institutes, which is evident from the well-structured curriculum for this major at both institutes.

One example of this mutual learning between the animation majors is the mandating of the students to maintain a workbook throughout the course of assignments and projects. The evaluation of the workbook is more focused on recording the creative thought process of the student rather than well-structured design steps. According to one animation teacher from DeTao, the thought recording process helped students revisit ideas that they may not have used in one project and may be able to use in another project. Another teacher at SIVA animation viewed the workbook as a system to record thoughts or topics that students come across during 'self-study', which is highly encouraged and is an important part of their teaching methodology. The whole idea of the workbook resonates with the idea of exploration, which is one of the teaching methods described in the Cognitive Apprenticeship Model.

SDI and Themed Environment Design majors have courses structured similarly, around yearly goals. In SDI major, good hand sketching and hand modelling skills are major focus areas. Students are given projects involving a three- step process – discover (brainstorm ideas based on problem definition), design (refine definition based on ideas) and define (repeated refinement). The themed environment design major has stimulating projects as well. A distinguishable characteristic of the themed environment design major at DeTao is their focus on teaching the students narration and storytelling to design environments. For example, one course in this major is called Revitalization and branding of a Village. Students are encouraged to complete a project in this course by focusing on telling the story of the village, which is observed to be more efficient in stimulating creative ideas among student groups.

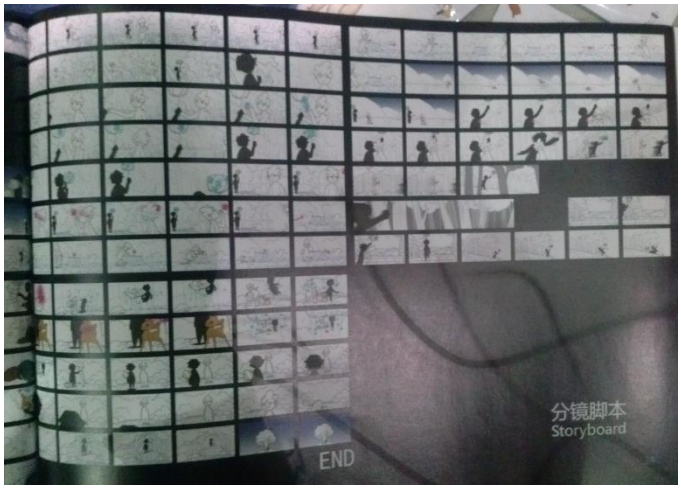

Figure 2: Storyboarding by DeTao Animation students

Though both SIVA and DeTao students scored equally in biographical creativity (BICB scores) and domain creativity (CDQ-R scores), the DeTao students possessed 16% higher design self-efficacy than the SIVA students. On delving further into the categories that constitute this self-efficacy survey, it was seen that the DeTao students were better than SIVA students in conducting design (by 21%), communicating a solution or design (by 30%) and re-designing (by 68%). There was no significance difference found in the rational and experiential thinking scores (REI scores) between students at SIVA and at DeTao.

4.3 Incorporation of Cognitive apprenticeship model in teaching style

The Cognitive Apprenticeship framework is evident in both the DeTao and SIVA teaching methodology and curriculum structure in all the majors, though to different extents. Based on interviews with the teachers, it was observed that the curriculum was structured with an aim similar to the Cognitive Apprenticeship

model. The different methodologies under Cognitive Apprenticeship – Modelling, Coaching, Scaffolding, Reflection, Articulation and Exploration – are not explicitly defined in the teaching methods, but they are meant to be emergent in the design process that the students undergo.
Animation major seems to be much well-set into this framework. Students use storyboards and similar methods to make their design thinking process visible. Coaching and scaffolding seem to be common in both institutes. Students get constant feedback and guidance on their projects and assignments. However, SIVA has a higher student to teacher ratio resulting in less individual attention to each student, and it was observed that this hindered open discussion in the classes. DeTao seems to be an at advantage in this regard with a lower student to teacher ratio and higher "graded" students (based on entrance exams needed to pass to be accepted here). The coaching method slowly turns to scaffolding once students get into the latter years of their programs and become more independent in their thoughts and ideas. No mentoring or reflection, however, was observed to be practiced in any of the majors in either institute.

DeTao classes seemed to focus a lot on articulation. It is an integral part of the teachers' work to prepare the students to present their work in front of other students and teachers. Based on the design self-efficacy scores calculated via the survey questionnaire, it was found that students at DeTao thought they can communicate solutions better than students at SIVA by 30%. The method of articulation practiced at DeTao may be a positive factor contributing to this self-efficacy score.

Exploration was also observed to be a sought-after method, particularly in the more artistic fields of design (Animation and themed environment design). The workbook, or project book method, that is a way of students to record their thought process while self-learning or doing an assignment or a project, seems to be a good method of enabling exploration of new ideas. However, the direction of this method needs to be channeled correctly for students to be able to actually benefit from it.

4.4 Teaching hours vs. Self-learning

One of the major differences between teaching methodologies at SIVA and DeTao is the utilization of teaching hours and the approach to project-based learning. In animation, for example, SIVA students go through lectures during teaching hours and projects are given as assignments. To complete these assignments, any additional learning is to be done through self-directed learning. The students do get time to ask for feedback and discuss about the projects, but most of the teaching hours constitute providing technical and tool knowledge (e.g. software). On the other hand, at DeTao, the methodology is more inclined towards creating a project-based learning environment. Only 2-3 classes for a course constitute of teaching technical know-how, while the rest are focused on feedback and discussion on the students' projects.

The same project-based approach was observed in other majors at DeTao. For example, year two themed environment design students are given a brief overview of a project aim, like building an interactive structure, and then introduced to tools they may need for the completion of projects in the first 2-3 classes, like Adobe software. Throughout the rest of the course, students are given continuous feedback and project discussions are used as a medium of gaining knowledge on the course and practicing the software. In SDI, the teachers focus not only on the student's technical know-how, but also on their leadership skills which are deemed important for professional work. The required skillset is learnt through projects, whereas the leadership skills are developed by working in groups and learning from seniors.

4.5 Individual vs. team work preference

A strong preference to team work was observed among students at both institutes and under all majors. Based on the survey questionnaire filled by students, 70% at DeTao and 75% at SIVA preferred a small team (with less than 5 people) to work in. The primary advantage that students found in working with teams was that they could work with each other's strengths and interest areas to complete the assignments and projects on-time.

Teachers in all the majors at both the institutes corroborated this observation of students' preference of team projects. However, to teach them how to work and think more independently, the curriculum comprises of individual assignments and projects as well, especially during the final two years of the majors. This shows evidence of a transition of the teaching methods from coaching and scaffolding to articulation and exploration as students move from the junior classes to senior ones.

Figure 3: SDI working space, shows a project on Biky

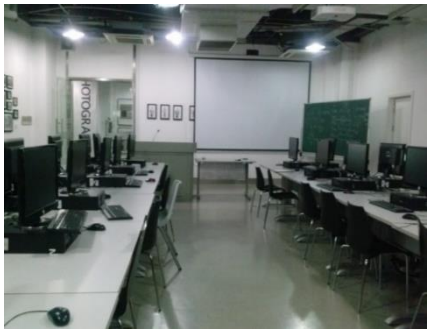

Figure 4: Learning space at SIVA

4.6 Learning environment and teaching resources

Based on teacher interviews, DeTao was observed to have better facilities and classes for teaching and learning when compared to SIVA. SIVA was found to be more resourceful for the professional development of teachers, however, in terms of versatility of areas that they could explore. Most students were overall satisfied with the resources but did mention having faced problems like slower software updates on available computer systems, and an overwhelming work load throughout the week that seemed to hinder their pursuit of other creative non-study related interests.

Figure 5: Working space for themed environment design, students can be seen working on a project to make an Intelligent Structure

5. DISUCSSION

The ethnographic study conducted at DeTao and SIVA helped prove both our hypothesis.

H1: Project-based learning structured within a Cognitive Apprenticeship model positively affects design self-efficacy in students when compared to traditional learning

H2: Design education requires the absence of modelling within the Cognitive apprenticeship framework.

H1 was supported by DeTao's efficient project-based learning approach, where theoretical and practical knowledge imparted to students was constructed around projects, and projects were constructed around skills needed to be learnt. SIVA's approach is more traditional, using lectures to impart knowledge, and projects are given as assignments. The efficiency of DeTao's approach is supported by the higher design self-efficacy in students at DeTao when compared to those in SIVA, by 16%, especially in conducting design, communicating solutions and re-designing.

H2 is supported by both the institutions' approach to teaching students. Modelling was observed to be absent, and did not affect student learning, or design self-efficacy, which was in the high range of 60-80 for students at both institutes. This hypothesis can be further strengthened if the self-efficacy scores of design students that do undergo modelling methodology of teaching is compared with those obtained from this study.

6. CONCLUSION

China is not a very open market for students in design, especially in the more artistic forms of design. Many students interviewed mentioned low entrance exam scores as a reason for choosing animation and themed environment design majors. In animation, students from both institutes were attracted by comic books (like Japanese Manga) and wished to gain professional exposure. However, the Chinese social outlook to art fields and a low post-graduation salary package in the fields of design, especially animation and Environment Design, were found to be key reasons for higher "graded" students not pursuing design fields. Most of the students interviewed wished to pursue higher studies in the US or Europe after graduation, due to the opportunities and "respect" associated with art in these countries. However, the lack of good communication skills in English prevent them from qualifying for good programs outside China.

The key challenges faced by both SIVA and DeTao are student self-regulation, poor presentation skills (especially in English), low student interest and motivation in their respective fields due to socio-economic factors and over-burdened student schedules. Though both institutes have well-structured curriculum, DeTao focuses more on a project-based, storytelling approach and fosters greater independent thinking in its students through a teaching methodology that resonates more with the Cognitive Apprenticeship Model. Coaching, scaffolding, articulation and exploration were evident in the teaching methods at DeTao, whereas SIVA needs to focus more on the articulation. Both the institutes focus on self-learning through projects, but DeTao's approach is much more well-structured than SIVA's, and its efficiency can be observed in the higher design self-efficacy scores of the students in the former institution. Out of all three majors, animation seems to be the most well-structured in both the institutes, and there exists a mutual learning and collaborative relationship between the institutes for this major that should be continued in the best interests of the students. The institutes should try to establish a similar relationship among other majors.

This study can be further expanded to compare the effects of personal, behavior and environmental factors on pro-design characteristics of design students in different fields of design. It can also be expanded to compare design students in China with those in other countries to identify other factors that can affect creative thinking and design self-efficacy in students. The inclusion of Design Performance as a Behavioral influencer and analyzing similar data with the design performance of students will further help in evaluating the effectiveness of the cognitive apprenticeship model on design education.

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