

學習環境與人格特質對學生想像力的綜合影響

The Combined Effects of Learning Environment and Personality Traits on Student Imagination

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摘要

本研究目的在分析學習環境與人格特質對教育科技學生想像力的綜合影響，並驗證以校系文化特質做為中介變項的效果。本研究結果顯示，想像力具有十項能力指標，學習環境可區分為五大因素。本研究——以文化特質做為中介變項——的假設獲得部份支持。結構方程分析顯示，多數人格特質變項都對學生想像力具有直接預測效果，而多數學習環境變項則對學生想像力具有間接的預測效果。本研究結果驗證學習環境與人格特質都會對教育科技學生的想像力產生影響，善加經營與應用將可激發學生的創造性想像與再造性想像。本文於資料分析與討論後提出實務與研究建議，研究限制亦有所說明。

關鍵字：教育科技、文化特質、想像力、學習環境、人格特質

Abstract

The purpose of the current study was to analyze the combined effects of both personality traits and learning environment on university student imagination of educational technology major, and to test the mediating effect resulted from the variable of human aggregate. The results of this study supported that imaginative capabilities were consisted of ten characteristics, and the influences of learning environment were composed of five indicators. The hypothesis of this study--that human aggregate plays a mediator in imagination-stimulation--was partially supported. The structural model also showed that most personality traits had direct effects on imagination,

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while most environmental variables had indirect effects. Our results highlighted the importance of understanding both the individual personality and learning environment for the educational technology students, so that optimal levels of reproductive imagination and creative imagination could ultimately be elicited.

Keywords: Educational technology, Human aggregate, Imagination, Learning environment, Personality traits

I. Introduction

Egan (2010) claimed that the average classroom is not successful when it comes to stimulating imaginations and sparking creativity in students, though we all know the importance of engaging imaginations and fostering creativity in the new century. Egan further indicated that imagination stimulation should be properly done across the curriculum in diverse and cross-field subjects. Swirski (2010) also asserted that how we envision, create and contribute to our educational, social and cultural landscapes is only limited by our imaginations. Imagination in designing learning environments will frame educational activities and facilitate innovative assessments which allow our students to explore, question, resolve, and make sense of the diversity and complexity surrounding them.

The infusion of technology has changed our learning environments. Almost all of us are struggling with how to integrate technology into a variety of educational settings. Fabricating such meaningful experiences not only requires a significant amount of expertise, but also creativity and imagination. It involves imagining how our learners learn, how they respond to a task, where they work, with whom, how, using what resources,

under what circumstances, and over what timescale (Goodyear & Retalis, 2010). We even need technological imagination in order to forecast the potential applications of emerging technologies and to design meaningful learning experiences. However, design rarely comes out right on the first attempt. It often involves ill-structured rather than well-formed problems (e.g., Jonassen, 2008). Therefore, Roschelle and Jackiw (2000) contended that designing educational experiences is an imaginative art.

As educational experience designers, it is important to pay attention on how learners learn, and how physical and social environments where technologies are used can influence learners' imagination. Taking these concerns into account, this study aims at analyzing the combined effects of both personality traits and learning environment on the imagination of educational technology major university students, and to test the mediating effect resulted from the variable of human aggregate. In this study, imagination refers to the process of transforming the inner imagery of educational technology students, when they face an instructional design task. Such images are usually developed from the individual's image memory and shaped into something new.

1.1 Imagination Studies

Imagination is a creative faculty of the mind (Perdue, 2003), it thus can be viewed as the vehicle of active creativity (Gaut, 2003). Heath (2008) held that imagination is one of the most important cognitive capacities for learning in that “it permits us to give credence to alternative realities” (p. 115). Betts (1916) contended that the activities of human imagination can be classified into two categories: reproductive imagination and creative imagination. Reproductive imagination is characterized by the ability to reproduce in their mind images described by others or from less accurate reflections or recalls of reality. Creative imagination, on the other hand, emphasizes the attributes of initiation and originality. Accordingly, reproductive imagination was composed of four capabilities namely: crystallization, dialectics, effectiveness, and transformation. Creative imagination comprised six capabilities namely: exploration, focusing, intuition, novelty, productivity, and sensibility (Liang, Hsu, Chang, & Lin, 2012).

With respect to reproductive imagination, imagination can bridge “images” and “ideas,” implying that rational thought takes place in the form of images (Perdue, 2003). Vygotsky (2004) also held that all objects of common life appear as a crystallization of the imagination. Cartwright and Noone (2006) added that imagination is what occurs as a person encounters new ideas and engages in confrontations with arguments and controversies. This is an experience of dialectics. Shin (1994) also claimed that problems are resolved only as imaginative anticipation begins searching for effective solutions to problems. In addition, Ribot (1906) held that the essential element of

imagination in the intellectual sphere is the capacity of thinking through analogies. The core principle behind analogy is transformation. Analogy/transformation enables children to learn how to control a situation through the use of symbols (Vygotsky, 1978).

In regards to creative imagination, Folkmann (2010) claimed that imagination can be seen as a structure in consciousness that negotiates, exchanges, and explores between the known and unknown. Folkmann further indicated that the process of focusing is open to ongoing reformulation in order to create and sustain an imaginative scenario. In addition, Townsend (2003) held that if people utilize more intuitive representations, then their imagination may last longer. Beaney (2005) also indicated that someone who is imaginative is good at creating novel possibilities, and able to offer fresh perspectives on what is familiar. Moreover, imagination corresponds to the quantity, intensity and duration of images (Ribot, 1906). All of these evolving conditions are related to physical dimensions of imaginative productivity, continuity and fluency. Finally, inventors strive to achieve their goals and overcome problems, often experiencing painful struggles (Ricoeur, 1978). Reichling (1990) also contended that most imagination is of emotive content, with an intuitively sensible meaning.

In summary, in the current study, with regard to creative imagination, exploration refers to an individual’s ability to explore the unknown. Focusing refers to an individual’s ability to formalize ideas through focus. Intuition refers to an individual’s ability to generate immediate

associations to the target. Novelty refers to an individual's ability to create uncommon ideas. Productivity refers to an individual's ability to productively generate ideas. Sensibility refers to an individual's ability to evoke feelings during the creative process. With respect to reproductive imagination, crystallization refers to an individual's ability to express abstract ideas by using concrete examples. Dialectics refers to an individual's ability to seek improvement by logically analyzing ideas. Effectiveness refers to an individual's ability to generate effective ideas about the goal. Transformation refers to an individual's ability to perform tasks by transforming what they know across multiple fields of knowledge.

1.2 Personality Influences

Personality traits illuminate the pattern of preferences that identifies the individual's approach to creativeness (Clarkson, 2005). Previous studies indicated that creative imagination, especially with regard to fluency, increases along with increase in openness to experience, conscientiousness and introversion (Karwowski, 2008). Researchers also have consistently reported a positive relationship between creativity-related personality (i.e., innovativeness, openness to experience, and tension towards novelty,) and creative performance (e.g., Barrick & Mount, 1991).

Imagination is different from creativity, but it is usually viewed as the basis for cultivating creative thinking, and thus the driving force of innovation (Finke, 1996; Robinson & Aronica, 2009). The current study extends the argument that both imaginative and creative people share common personality traits, and these traits, in turn, may influence their imagination. This argument

has been indirectly supported by the series studies of Furnham and associates (e.g., Furnham, Batey, Anand, & Manfield, 2008; Furnham & Nederstrom, 2010).

Over the years, there are mounting studies that have investigated the relationship between personality and creativity (Gelade, 2002). Numerous Big Five researchers have found that creative individuals have high Openness to Experience, low Agreeableness, low Conscientiousness, high Extraversion and high Neuroticism (e.g., McCrae, 1987; Prabhu, Sutton, & Sauser, 2008). Previous studies also showed that employees who score high on openness to experience value environmental conditions that support creativity (e.g., supervisory encouragement) and respond to these conditions by exhibiting high creativity. Conversely, those who score lower on openness tend to devalue these conditions and respond less positively to them (e.g., George & Zhou, 2001).

Personality type indicates how people relate to each other and fosters mutuality and collaboration in the group (Clarkson, 2005). Anderson, Spataro, and Flynn (2008) found that extraverts attained more influence in a team-oriented organization, whereas conscientious individuals attained more influence in an organization in which individuals worked alone on technical tasks. In addition, Ahmed, Campbell, Jaffar, and Alkobaisi (2010) further indicated that students possessing the personality traits of Introversion, Sensing, Thinking, and Judgment performed at a consistently higher level than any other group of students. Ahmed et al. also found that those students who were classified as ENTJ (Extroversion, Intuition, Thinking,

and Judgment) also demonstrated high levels of attainment.

In addition, Barron and Harrington (1981) reported, individuals with high creativity showed high energy, independence of judgment, self-confidence, and persistent in the face of barriers. Other traits were discussed such as curiosity and complexity (e.g., Williams, 1994), cognitive flexibility (e.g., Zabelina & Robinson, 2010), playfulness and sense of humor (e.g., Proyer & Ruch, 2011), need for achievement and autonomy (e.g., Feist, 1999), as well as tension towards novelty, risk-taking, eager to cooperate, autonomous, and have high self-esteem (e.g., Lee, 2005; McCrae, 1987).

1.3 Environmental Influences

Many studies have elucidated the role of environment in creativity. For example, Amabile, Conti, Coon, Lazenby, and Herron (1996) recognized crucial environmental conditions that nurture creativity: freedom, sufficient resources, challenging work, work group support, supervisory encouragement, and absence of organizational impediments. Some researchers have argued that environmental variables, more than personal characteristics, determine individuals' influence in organizations (e.g., Brass, 1984). There are other scholars who argue that influence can also come from personal characteristics, specifically, from the fit between the person's characteristics and those of the organization (e.g., Chatman & Barsade, 1995).

The campus environment can be divided into four dimensions: its physical components and design, its dominant human characteristics, the organizational structures that serve its purposes,

and the participants' constructions of its social climate (American College Personnel Association, 1994). The physical component dimension of a campus consists of its natural environment and man-made environment. Both components define space for activities and events, thereby encouraging some phenomena while limiting others (Strange, 2000). There are numerous follow-up studies which indicate that the environment has a profound impact on student imagination (e.g., Büscher, Eriksen, & Kristensen, 2004; Claxton, Edwards, & Scale-Constantinou, 2006).

The organizational measure dimension arises from the myriad decisions made about environmental purposes and functions (Strange, 2000). As a result of this need, rules and regulations are formed, rewards systems are developed, and reports become necessary for resource allocation. Many studies by modern scholars (e.g., Claxton et al., 2006; Kangas, 2010) also give evidence as to the influence of organizational measures on the development of student imagination.

The social climate dimension focuses on the subjective experiences of participants, and can be described in terms of their social climates (Moos, 1979; Strange & Banning, 2001). The social climate has both intrinsic influence and external impact. McMillan (1995) thus held that all schools should create a context that is full of encouragement and support in order to cultivate students' imagination.

The human aggregate dimension represents the collective characteristics of people who inhabit the environment. This dimension is about the person-environment interactions, and reduces environmental differences to the collective effects of members' characteristics, personalities,

and types (Komives & Woodard, 2003, p.302). Congruent person-to-environment matches allow individuals to exercise their strengths and to avoid their weaknesses. Moreover, the human aggregate dimension creates features in an environment that reflect varying degrees of consistency, especially in terms of organizational culture, tradition or style (Huebner & Lawson, 1990).

Furthermore, according to the recent studies in learning environments (e.g., Gislason, 2010), student learning should be separated as an independent variable to be studied. Kember, Ho, and Hong (2010) also indicated that student motivation can be enhanced through several supportive conditions, namely establishing relevance, establishing interest, allowing choice of courses, learning activities, teaching for understanding, assessment of learning activities, close teacher–student relationships, and sense of belonging between classmates. Therefore, the present study took learning resources into account to explore the impact of a campus environment on student imagination.

In summary, in the current study, physical component reflects the degree to which participants felt the spaces and facilities in an environment stimulated their imagination. Human aggregate assesses the extent that the imagination is influenced by the organizational culture and its dominant human characteristics by the participants. Organizational measure measures participant perception of the influence of organizational structure and instructional measures. Social climate reflects the extent to which participants reported being influenced by the climate of the class. Learning resources appraises the degree to which

participants felt the messages and activities in their environment stimulated their imagination.

1.4 Hypotheses

Vygotsky (1978) contended that human development cannot be separated from its social context, learning leads to **development, and learning is mediated** though interactions with cultural tools and symbol systems. To be more specific, Amabile et al. (1996) suggested that to fully understand creativity needs to consider both individual personality and contextual variables. Numerous studies have found that personality traits are positively related to organizational culture and climate (e.g., Rasulzada, 2007). Previous research supported that organizational culture could be affected by physical setting (e.g., Lindahl, 2006) and institutional resources (e.g., Ekvall, 1996).

In regards to the issue of supportive climate, Oldham and Cummings (1996) found that **employees generate creative suggestions when they have creative personalities, hold autonomous jobs, and are managed in a supporting fashion**. Zhou and Oldham (2001) concluded that individuals, who have **creative personalities, exhibit the highest creative performance when they expect an opportunity to assess their own works in order to develop their creativity-related skills**. Madjar and Oldham (2002) indicated that the informal social interactions with **coworkers have an impact on employees' creativity**. Shalley, Zhou, and Oldham (2004) concluded that research regarding social networks is needed to examine the relationship between certain personalities and belonging networks.

Taking into account both the crucial role of human aggregate on stimulated imagination, the research team hypothesized that human aggregate

would play a mediating role between the influential variables and imagination. Subsequently, the following relationships were hypothesized in this study:

- Hypothesis 1.** Human aggregate is positively associated with both reproductive and creative imagination.
- Hypothesis 2.** Human aggregate mediates the effects of personality traits and both types of imagination.
- Hypothesis 3.** Human aggregate mediates the effects of environmental influences and both types of imagination.

Figure 1 summarizes the three sets of variables examined in the present study and their hypothesized relationships with respect to imagination

II. Method

2.1 Participants and procedure

The hypothesized model was tested with data from six universities across different regions (i.e., Taipei, New Taipei, Taichung, Chiayi, and Yilan) in Taiwan. The participants in this study were students in educational technology programs from these universities. These programs are the major academic institutions for talent development for

the field of educational technology in Taiwan. The students learned and performed instructional design tasks that required substantial imagination to be effective. In order to ensure the quality of this study, the research team discussed the survey content with instructors in the target programs first, and then arranged similar assignments and schedules. Therefore, this study could be implemented across campuses under a comparable timetable with similar design tasks. The investigation process delivered in each program followed the same procedure. Participation was voluntary and guaranteed anonymity.

In the questionnaire, the students were asked to determine their level of agreement with regard to each imaginative capability (Liang, Hsu, Chang et al., 2012) and each item of Thompson's (2008) big-five Mini-Markers, and the strength of environmental influence that each item (Liang, Hsu, Huang, & Chen, 2012) had on their imagination. The survey delivered in each program followed the same procedure and taken in the tutorial groups who were accompanied by the class instructor. In this manner, the problems participants faced when answering the questions could be resolved directly. Of the 912 participants, 824 completed all the parts of this study. The majority (68.1%) was female; 39.4% were juniors, 33.3% were sophomores, 24%

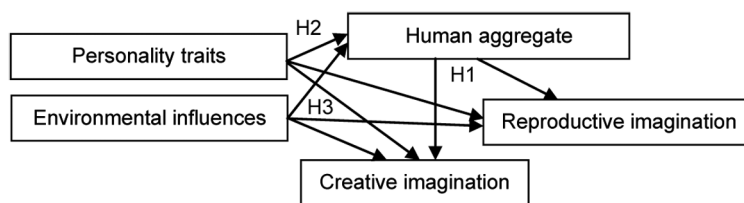


Figure 1. Hypothesized model of the present study.

were seniors, and 3.3% were graduate students.

2.2 Measures

2.2.1 Imaginative capability

Based on Liang, Hsu, Chang et al. (2012), the measure for imaginative capability was a 10-item scale which was composed of two dimensions: reproductive imagination and creative imagination. The reproductive imagination dimension comprised items of crystallization, dialectics, effectiveness, and transformation. The creative imagination dimension comprised items of exploration, focusing, intuition, novelty, productivity, and sensibility. Respondents answered on a six-point scale ranging from 1 = strongly disagree to 6 = strongly agree. Some representative items are: “I often have uncommon ideas compared to others” (refers to novelty, Cronbach’s $\alpha = .83$), “I often help myself imagine by arousing personal feelings” (refers to sensibility, Cronbach’s $\alpha = .81$), and “I am good at seeking improvement by logically analyzing ideas” (refers to dialectics, Cronbach’s $\alpha = .86$).

2.2.2 Big-five mini-markers

Based on Thompson (2008), personality traits were measured with a 40-item scale. Before set-up of the survey, this scale was translated from English to Chinese and then translated back into English by three independent bilingual individuals to ensure equivalency of meaning (Brislin, 1980). Respondents answered on a five-point scale ranging from 1 = strongly disagree to 5 = strongly agree. The Cronbach’s α for the Extraversion sub-scale was .88, that for Openness was .77, that for Emotional Stability was .80, that for Conscientiousness was .85, and that for Agreeableness was .76.

2.2.3 Environmental influences

Based on Liang, Hsu, Huang et al. (2012), environmental influences were measured with a 21-item scale which was composed of five subscales namely: physical component, learning resources, organizational measure, social climate, and human aggregate. Respondents answered on a six-point scale ranging from 1 = strongly disagree to 6 = strongly agree. Some representative items are: “Public spaces for creation, discussion and exhibitions” (refers to physical component, Cronbach’s $\alpha .74$), “Dynamic audiovisual stimuli such as rhythm, sound, and movies” (refers to learning resources, Cronbach’s $\alpha .83$), “Teacher’s encouragement and praise for taking risk” (refers to organizational measure, Cronbach’s $\alpha .91$), “Communication and discussion with classmates” (refers to social climate, Cronbach’s $\alpha .90$), and “There is a culture on campus of putting imagination into practice” (refers to human aggregate, Cronbach’s $\alpha .87$).

III. Results

3.1 Descriptive analysis

The data was analyzed using SPSS 17.0 software. The results of descriptive analysis, with regard to the means, the standard deviations, and the correlation among variables, are illustrated in Table 1.

3.2 CFA and Mediating effect

Confirmatory factor analysis (CFA) with the maximum likelihood estimator was performed with LISREL 8.80 to determine the appropriate structure of the developed scales. The research team used the following indicators recommended by Hu and

Table 1. The M, SD, and Correlation among variables

Variables	M	SD	1	2	3	4	5	6	7	8	9	10	11	12
1.Reproductive imagination	4.42	.65	--											
2.Creative imagination	4.31	.66	.67*	--										
3.Extraversion	3.35	.76	.15*	.21*	--									
4.Openness	3.36	.58	.50*	.56*	.11*	--								
5.Emotional Stability	3.14	.63	-.07*	-.07*	.00	-.14*	--							
6.Conscientiousness	3.36	.63	.33*	.25*	.13*	.33*	-.15*	--						
7.Agreeableness	3.90	.51	.20*	.15*	.20*	.13*	-.17*	.19*	--					
8.Physical component	4.55	.72	.12*	.14*	.04	.08*	.05	.05	.13*	--				
9.Learning resources	4.54	.79	.15*	.12*	.08*	.07*	.03	.04	.11*	.49*	--			
10.Organizational measure	4.98	.77	.18*	.14*	.08*	.10*	-.01	.11*	.18*	.44*	.50*	--		
11.Social climate	5.40	.67	.17*	.13*	.15*	.05	.06	.03	.17*	.35*	.36*	.56*	--	
12.Human aggregate	4.56	.99	.15*	.16*	.12*	.09*	.05	.06	.16*	.28*	.43*	.51*	.41*	--

* $p < .05$.

Bentler (1999) and Tabachnick and Fidell (2001) to assess goodness of model fit: CFI (.95 or above), RMSEA (.05 or below), SRMR (.05 or below), TLI (.95 or above). With respect to imaginative capability, the two-factor model yielded an excellent fit for this study ($X^2 = 2202.54$, $df = 923$, $p < .005$, CFI = .96, RMSEA = .042, SRMR = .042, TLI = .97). The CFA of environmental influence scale also showed an acceptable fit for the data.

The hypotheses of the current study suggested that three sets of variables (human aggregate, personality traits, and environmental influences) stimulate imagination, and that human aggregate mediates the effects of the other two clusters of variables on imagination. The research team tested the mediating effect of the present study based on the four steps provided by MacKinnon,

Lockwood, Hoffman, West, and Sheets (2002). According to our analysis, the relation between influential variables and both types of imagination was significantly reduced, when the mediator was included in the model. Thus, the mediation model was supported.

3.3 Model test

Although the predicted model showed a good fit to the present data, **not all variables were significantly associated** with two types of imagination. The research team removed the non-significant paths and then revised the structural model. In the final model, only the paths of learning resources, organizational measure, and social climate to the mediator were kept. In addition, the model also showed that physical component, extraversion, openness, conscientiousness, and agreeableness

have direct effects on either or both types of imagination.

This final model showed a model fit comparable to that of the initial model, $X^2 = 2003.16$, $df = 819$, $p < .005$, $CFI = .97$, $RMSEA = .045$, $SRMR = .044$, $TLI = .97$. It accounted for substantial variance in human aggregate ($R^2 = .38$), reproductive imagination ($R^2 = .45$) and creative imagination ($R^2 = .46$). The path of human aggregate (the mediator) to reproductive imagination was removed due to its non-significance, and the standardized path coefficient of human aggregate to creative imagination was $.07^*$. Thus, the mediating effect was only partially affirmed.

With regard to predictor variables, our results showed that most personality traits have direct effects on imagination, while most environmental influences have indirect effects. Openness owned the strongest direct effects on reproductive imagination ($.50^*$) and creative imagination ($.63^*$). Both conscientiousness and agreeableness had direct effects on reproductive imagination ($.20^*$, $.07^*$). Extraversion only held a direct effect on creative imagination ($.10^*$). Physical component in the environmental influence also had a direct effect on creative imagination ($.09^*$). Learning resources contained both direct and indirect effects on imagination. Its direct effect on reproductive imagination was $.10^*$, and the indirect effect on creative imagination was $.015^*$. Similarly, social climate also had its direct effect on reproductive imagination ($.10^*$) and indirect effect on creative imagination ($.009^*$). At the same time, the indirect effect resulted from organizational measure on creative imagination was $.026^*$.

The case of model trimming suggested that the

final model is more presentable, and hence, should be supported. Overall, the SEM results summarized in Figure 2 partially support the present hypotheses. Human aggregate directly influenced creative imagination other than reproductive imagination (Hypothesis 1 was partially supported). Also partially supporting the mediating hypotheses (Hypothesis 2 and 3), three environmental variables (learning resources, social climate, and organizational measure) influenced creative imagination through their impact on human aggregate. The correlation of latent predictor variables is reported in Table 2.

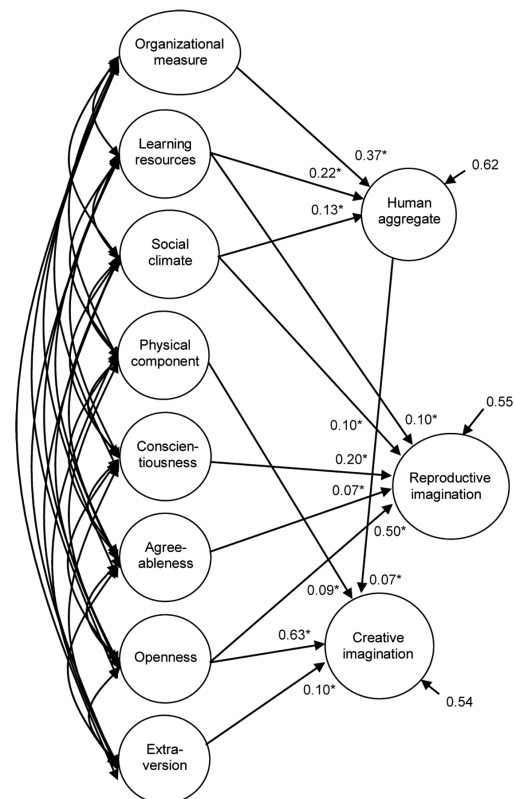


Figure 2. The effects of influential variables on both types of imagination.

Table 2. The correlation of latent independent variables

Variables	1.	2.	3.	4.	5.	6.	7.	8.	Direct effect		Indirect effect	
									RI	CI	RI	CI
1. Extraversion	--								--	.10*	--	--
2. Openness	0.16*	--							.50*	.63*	--	--
3. Conscientiousness	0.17*	0.41*	--						.20*	--	--	--
4. Agreeableness	0.25*	0.15*	0.20*	--					.07*	--	--	--
5. Physical component	0.03	0.08*	0.06	0.16*	--				--	.09*	--	--
6. Learning resources	0.10*	0.07	0.05	0.13*	0.54*	--			.10*	--	--	.015*
7. Organizational measure	0.09*	0.12*	0.11*	0.21*	0.47*	0.55*	--		--	--	--	.026*
8. Social climate	0.16*	0.04	0.04	0.21*	0.38*	0.39*	0.61*	--	.10*	--	--	.009*

Note: RI = Reproductive Imagination, CI = Creative Imagination

* $p < .05$.

IV. Discussion

While philosophical studies abound on the influences of personality traits and human aggregate on imagination, little articulates about imaginative capabilities, nor the variables that may directly or indirectly affect these capabilities. The current study proposed and examined a mediation model of human aggregate in which individual personality and learning environment, both directly and indirectly influenced the creative and reproductive imagination of educational technology university students. Given the observed gap in the literature, the results of this study increase the understanding of the influences from the long-standing individual personality and the context-dependent human aggregate on imagination development.

4.1 Imaginative Capabilities

In summary, the results of this study supported the earlier study that imaginative capabilities could be categorized into two groups (Liang, Hsu, Chang et al., 2012). First, reproductive imagination consisted of crystallization, dialectics, effectiveness

and transformation. Second, creative imagination comprised exploration, focusing, intuition, novelty, productivity and sensibility. While in no way definitive or exhaustive, nonetheless, the study has yielded a path for further inquiries. For example, it would be interesting to elaborate each imaginative capability and clarify its uses. It is even more important to make each imaginative capability assessable and to form feasible behavioral measures or capability tests.

4.2 Effects on Reproductive Imagination

It is not surprising to find that the personality of openness to experience to be positively related to reproductive imagination. In fact, many scholars identified openness as most related to imagination (e.g., Barrick & Mount, 1991). Openness is also associated with being intellectual, cultured, curious, original, broad-minded and artistically sensitive. The present study lent additional supports to this credence. What surprised us about evidence shown in this study is that conscientiousness and agreeableness were positively associated with reproductive imagination as well. Few studies have

implied, let alone articulated, this relationship. It may be because that previous imaginative studies largely focused on creative imagination, and overlooked the mental reproductive capability. The present study especially contributes to the understanding of both personalities of conscientiousness and agreeableness as driving forces to stimulate our students' reproductive imagination.

Our data also showed that reproductive imagination would be directly influenced by both variables of learning resources and social climate in a learning environment, which echoes Strange's series studies. Especially, instructional strategies such as the provision on dynamic audiovisual stimuli and simulation-based instruction, as well as opportunities for discussion with and support from classmates, could be essential to trigger this type of imagination. It was surprising to discover that there was no significant, indirect effect through human aggregate on reproductive imagination. These findings open a promising area for further research. To improve the student's reproductive imagination, it thus may be important to use the following strategy: encourage our students to be more conscientious and open to various life experiences, enhancing with effective learning resources and high-quality social climate. There is little academic discussion of this issue in the field of educational technology, which underlines a demand for more efforts to be devoted to this research in the future.

4.3 Effects on Creative Imagination

It is the personality of openness that had the greatest impact on creative imagination. The trait of extraversion also showed a positive, direct effect on this type of imagination, which is compatible

with previous studies on the personality of creative fellows (e.g., Furnham & Nederstrom, 2010). In regards to learning environment, physical component was the only variable, that had a slight but significant, direct effect on creative imagination. Consistent with the relevant literature (e.g., Büscher et al., 2004; Claxton et al., 2006), this finding shed light on the critical role, which campus spaces and production facilities may play, to stimulate student imagination, especially in terms of originality and initiation.

The current study hypothesized that human aggregate can play a facilitative role in augmenting identified influential variables in regards to both types of reproductive and creative imagination. Our findings partially supported this hypothesized mediating relation. According to the data, human aggregate seemed not affected by any personality trait, but did show its facilitative role for the environmental variables of learning resources, organizational measure and social climate. No matter what forms of imagination were kindled by encouraging culture, campus tradition, or respect for individual differences, human aggregate proved to be a key to trigger student creative imagination, but with no mediating effects on reproductive imagination.

These results may suggest that strategies of organizational measures paired with learning resources and social climate should be integrated and become the organizational culture, in order to trigger the student's creative imagination. This also suggests that each instructor needs to encourage his or her students to be more open to diverse life experiences, and each educational technology program should focus on strengthening its

instructional environment and facilities in order to kindle student imagination, especially the creative one.

4.4 Limitations

As is the case with all studies, this one has limitations. First, although the final model fits the data well, the predictive validity could be stronger. Similar to multiple influential variables on human creativity (Shalley et al., 2004), both individual personality and environmental influences are but two variables stimulating learners' imagination. Additional variables, such as the learner's psychological states and his or her ethnicity, should be taken into future account. Such an inquiry might enable tracing the complex interplay of multiple influences.

The second limitation is the use of a self-reported questionnaire. The choice of research tools however, was justified by the preliminary nature of the study. The questions asked in our survey did not have sensitive items that would cause the respondents to present themselves in a more socially acceptable manner. Furthermore, using self-report surveys enables us to study large samples of students. Following Chan's (2009) discussion of self-report measures, the samples of our study were large enough across universities to allow us to generalize our findings to a larger population.

V. Conclusion

While studies abound on the philosophical discussion in regards to the influence of possible variables on imagination development, little articulates about imaginative capabilities, nor the

variables that may mediate the relation between influential variables and imagination. Given this observed gap in the literature, this study uniquely analyzed how human aggregate acted as a mediator through which environmental variables might affect our students' creative imagination. It also illuminated the critical role personality traits could play to trigger student reproductive imagination. Particularly, openness to experience was identified as the most influential variable on imagination.

The trait of extraversion showed a positive effect on creative imagination, while conscientiousness and agreeableness had positive effects on reproductive imagination. In regards to learning environment, physical component was the only variable that had a significant but slight effect on creative imagination. With respect to reproductive imagination, it would be directly influenced by learning resources and social climate in a learning environment.

To sum up, all results highlighted the importance of understanding both the individual personality and learning environment for the educational technology students, so that optimal levels of reproductive imagination and creative imagination could ultimately be elicited. Although the limitations of this study must be kept in mind, the results reported here provide intriguing insights into the complexities of human imagination. Preliminary work such as this always raises a battery of issues and questions. Nevertheless, a great deal of research needs to be further conducted in this area.

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References

- Ahmed, F., Campbell, P., Jaffar, A., & Alkobaisi, S. (2010). Learning & personality types: A case study of a software design course. *Journal of Information Technology Education: Innovations in Practice*, 9, IIP 237-252.
- Amabile, T. M., Conti, R., Coon, H., Lazenby, J., & Herron, M. (1996). Assessing the work environment for creativity. *Academy of Management Journal*, 39, 1154-1184.
- American College Personnel Association. (1994). *The student learning imperative: Implications for student affairs*. Washington, DC: American College Personnel Association.
- Anderson, C., Spataro, S. E., & Flynn, F. J. (2008). Personality and organizational culture as determinants of influence. *Journal of Applied Psychology*, 93, 702-710.
- Barrick, M. R., & Mount, M. K. (1991). The big five personality dimensions and job performance: A meta-analysis. *Personnel Psychology*, 44, 1-26.
- Barron, F., & Harrington, D. M. (1981). Creativity, intelligence, and personality. *Annual Review of Psychology*, 32, 439-476.
- Beaney, M. (2005). *Imagination and creativity*. Buckinghamshire, UK: Open University Worldwide.
- Betts, G. H. (1916). *The mind and its education*. New York: Appleton.
- Brass, D. J. (1984). Being in the right place: A structural analysis of individual influence in an organization. *Administrative Science Quarterly*, 29, 518-539.
- Brislin, R. W. (1980). Translation and content analysis of oral and written material. In H. C. Triandis & J. W. Berry (Eds.), *Handbook of cross-cultural psychology* (Vol. 2, pp. 349-444). Boston, MA: Allyn & Bacon.
- Büscher, M., Eriksen, M. A., & Kristensen, J. F. (2004). *Ways of grounding imagination*. Retrieved March 26, 2012, from http://www.daimi.au.dk/Workspace/site/content/heading_07/papers/PDC2004.pdf
- Cartwright, P., & Noone, L. (2006). Critical imagination: A pedagogy for engaging pre-service teachers in the university classroom. *College Quarterly*, 9(4), 1-14.
- Chan, D. (2009). So why ask me? Are self report data really that bad? In C. E. Lance & R. J. Vandenberg (Eds.), *Statistical and methodological myths and urban legends: Doctrine, verity and fable in the organizational and social sciences* (pp. 309-335). New York: Routledge.
- Chatman, J. A., & Barsade, S. G. (1995). Personality, organizational culture, and cooperation: Evidence from a business simulation. *Administrative Science Quarterly*, 40, 423-443.

- Clarkson, A. (2005). Educating the creative imagination: A course design and its consequences. *Jung: the e-Journal of the Jungian Society for Scholarly Studies*, 1(2). Retrieved February 15, 2012, from <http://www.thejungiansociety.org/Jung%20Society/e-journal/Volume-1/Clarkson-2005.html>
- Claxton, G., Edwards, L., & Scale-Constantinou, V. (2006). Cultivating creative mentalities: A framework for education. *Thinking Skills and Creativity*, 1(1), 57-61.
- Egan, K. (2010). Preface. In K. Egan & K. Madej (Eds.), *Engaging imagination and developing creativity in education*. Newcastle upon Tyne, UK: Cambridge Scholars.
- Ekvall, G. (1996). Organizational climate for creativity and innovation. *European Journal of Work and Organizational Psychology*, 5, 105-123.
- Feist, G. J. (1999). Autonomy and independence. In M. A. Runco & S. R. Pritzker (Eds.), *Encyclopedia of creativity: Vol. 1, A-H* (pp. 157-163). San Diego, CA: Academic Press.
- Finke, R. A. (1996). Imagery, creativity, and emergent structure. *Consciousness and Cognition*, 5, 381-393.
- Folkmann, M. N. (2010, November 29-December 1). Enabling creativity. Imagination in design processes. Paper presented at the 1st International Conference on Design Creativity ICDC 2010, Kobe, Japan.
- Furnham, A., Batey, M., Anand, K., & Manfield, J. (2008). Personality, hypomania, intelligence and creativity. *Personality and Individual Differences*, 44, 1060-1069.
- Furnham, A., & Nederstrom, M. (2010). Ability, demographic and personality predictors of creativity. *Personality and Individual Differences*, 48, 957-961.
- Gaut, B. (2003). Creativity and imagination. In B. Gaut & P. Livingston (Eds.), *The creation of art* (pp. 148-73). Cambridge, UK: Cambridge University Press.
- Gelade, G. A. (2002). Creative style, personality and artistic endeavour. *Genetic, Social and General Psychology Monographs*, 128, 213-234.
- George, J. M., & Zhou, J. (2001). When openness to experience and conscientiousness are related to creative behavior: An interactional approach. *Journal of Applied Psychology*, 86, 513-524.
- Gislason, N. (2010). Architectural design and the learning environment: A framework for school design research. *Learning Environments Research*, 13, 127-145.
- Goodyear, P., & Retalis, S. (2010). *Technology-enhanced learning: Design patterns and pattern languages*. Rotterdam, Netherlands: Sense Publishers.
- Heath, G. (2008). Exploring the imagination to establish frameworks for learning. *Studies in Philosophy and Education*, 27, 115-123.
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6, 1-55.
- Huebner, L. A., & Lawson, J. M. (1990). Understanding and assessing college environment. In D. G. Creamer (Ed.), *College student development: Theory and practice for the 1990s* (pp. 127-151). Alexandria, VA: ACPA.
- Jonassen, D. H. (2008). Instructional design as design problem solving: An iterative process. *Educational Technology*, 48(3), 21-26.

- Kangas, M. (2010). Creative and playful learning: Learning through game co-creation and games in a playful learning environment. *Thinking Skills and Creativity*, 5, 1-15.
- Karwowski, M. (2008). Measuring creativity using the Test of Creative Imagination (TCI). Part 2. On validity of the TCI. *New Educational Review*, 15, 216-231.
- Kember, D., Ho, A., & Hong, C. (2010). Characterising a teaching and learning environment capable of motivating student learning. *Learning Environments Research*, 13, 43-57.
- Komives, S. R., & Woodard, D. K. (2003). *Student services: A handbook for the profession* (4th ed.). San Francisco: Jossey-Bass.
- Lee, K. H. (2005). The relationship between creative thinking ability and creative personality of preschoolers. *International Educational Journal*, 6, 194-199.
- Liang, C., Hsu, Y., Chang, C.-C., & Lin, L.-J. (2012). In search of an index of imagination for virtual experience designers. *International Journal of Technology and Design Education*, DOI: 10.1007/s10798-012-9224-6.
- Liang, C., Hsu, Y., Huang, Y., & Chen, S.-C. (2012). How learning environments can stimulate student imagination. *The Turkish Online Journal of Educational Technology*, 11, 432- 441.
- Lindahl, R. (2006). The role of organizational climate and culture in the school improvement process: A review of the knowledge base. Retrieved March 30, 2012, from <http://cnx.org/content/m13465/latest/>
- MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods*, 7, 83-104.
- Madjar, N., & Oldham, G. R. (2002). Preliminary tasks and creative performance on a subsequent task: Effects of time on preliminary tasks and amount of information about the subsequent task. *Creativity Research Journal*, 14, 239-251.
- McCrae, R. R. (1987). Creativity, divergent thinking, and openness to experience. *Journal of Personality and Social Psychology*, 52, 1258-1265.
- McMillan, M. (1995). *Education through the imagination*. Bristol, England: Thoemmes Press.
- Moos, R. H. (1979). *Evaluating educational environments: Procedures, measures, findings, and policy implications*. San Francisco: Jossey-Bass.
- Oldham, G. R., & Cummings, A. (1996). Employee creativity: Personal and contextual factors at work. *Academy of Management Journal*, 39, 607-634.
- Perdue, K. (2003). Imagination. *The Chicago school of media theory*. Retrieved October 16, 2011, from <http://lucian.uchicago.edu/blogs/mediatheory/keywords/imagination/>
- Prabhu, V., Sutton, C., & Sauser, W. (2008). Creativity and certain personality traits: Understanding the mediating effect of intrinsic motivation. *Creativity Research Journal*, 20, 53-66.
- Proyer, R. T., & Ruch, W. (2011). The virtuousness of adult playfulness: the relation of playfulness with strengths of character. *Psychology of Well-Being: Theory, Research and Practice*, 1(4), 1-12.
- Rasulzada, F. (2007). *Organizational creativity and psychological well-being*. Lund, Sweden: Lund University.

- Reichling, M. J. (1990). Images of imagination. *Journal of Research in Music Education*, 38, 282-293.
- Ribot, T. (1906). *Essay on the creative imagination*. Chicago: Open Court.
- Ricoeur, P. (1978). The metaphorical process as cognition, imagination, and feeling. *Critical Inquiry*, 5, 143-159.
- Robinson, K., & Aronica, L. (2009). *The element: How finding your passion changes everything*. New York: Penguin.
- Roschelle, J., & Jackiw, N. (2000). Technology design as educational research: Interweaving imagination, inquiry and impact. In A. E. Kelly & R. A. Lesh (Eds.), *Handbook of research design in mathematics and science education* (pp. 777-798). Mahwah, NJ: Lawrence Erlbaum Associates.
- Shalley, C. E., Zhou, J., & Oldham, G. R. (2004). The effects of personal and contextual characteristics on creativity: Where should we go from here? *Journal of Management*, 30, 933-958.
- Shin, U. (1994). The role of imagination in integrative knowledge: A Polanyian view. *Tradition and Discovery: The Polanyi Society Periodical*, 21(2), 16-28.
- Strange, C. (2000). Creating environments of ability. *New Directions for Student Services*, 91, 19-30.
- Strange, C. C., & Banning, J. H. (2001). *Educating by design: Creating campus learning environments that work*. San Francisco: Jossey-Bass.
- Swirski, T. (2010). *Unleashing the imagination in learning, teaching and assessment: Design perspectives, innovative practices and meaning making*. Paper presented at the ATN Assessment Conference, Australian Technology Network, Australia.
- Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics* (4th ed.). Boston: Allyn and Bacon.
- Thompson, E. R. (2008). Development and Validation of an International English Big-Five Mini-Markers. *Personality and Individual Differences*, 45, 542-548.
- Townsend, D. (2003). Cohen on Kant's aesthetic judgements. *British Journal of Aesthetics*, 43, 75-79.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
- Vygotsky, L. S. (2004). Imagination and creativity in childhood. *Journal of Russian and East European Psychology*, 42(1), 7-97.
- Williams, F. (1994). *Test della creatività e pensiero divergente*. Trento: Centro Studi Erickson.
- Zabelina, D. L., & Robinson, M. D. (2010). Creativity as flexible cognitive control. *Psychology of Aesthetics, Creativity, and the Arts*, 4, 136-143.
- Zhou, J., & Oldham, G. R. (2001). Enhancing creative performance: Effects of expected developmental assessment strategies and creative personality. *Journal of Creative Behavior*, 35, 151-167.
- Zhou, J., & Shalley, C. E. (2003). Research on employee creativity: A critical review and directions for future research. In J. Martocchio, H. Liao, & A. Joshi (Eds.), *Research in personnel and human resource management* (pp. 165-217). Oxford, UK: Elsevier.

