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多媒體學生的想像促發：

做中悟的中介效果

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Inspiration through Action

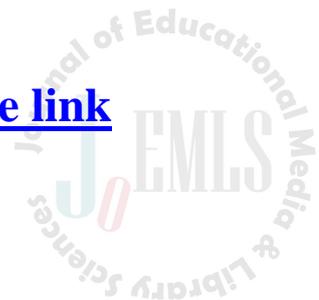
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**[English Abstract & Summary see link](#)**

**[at the end of this article](#)**





# What Stimulates Web Design Students' Imagination? The Mediator Effect of Inspiration through Action

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## Abstract

*This study aimed to analyze what psychological and environmental variables influenced the imagination of web design university students, and the effects these variables had on their imagination. A survey (n = 821) was administered from seven universities across different regions of Taiwan. The results of this study supported that imaginative capabilities consisted of ten characteristics namely: concentration, crystallization, dialectics, effectiveness, exploration, intuition, novelty, productivity, sensibility, and transformation. The psychological influences were comprised of six indicators namely: generative cognition, intrinsic motivation, positive emotion, negative emotion, inspiration through action, and self-efficacy. The environmental influences were composed of five indicators namely: physical component, learning resources, organizational measure, social climate, and human aggregate. The hypothesis of the study that inspiration through action plays a mediator in imagination development was partially supported. The structural model also showed that the variables of human aggregate, generative cognition, intrinsic motivation, negative emotion and self-efficacy have significant and indirect effects on imagination. Reflections on talent development of web design were proposed, future inquiries were discussed, and limitations of the study were acknowledged.*

**Keywords:** *Environmental influences; Imagination; Inspiration through action; Mediator effects; Psychological influences*

## Introduction

People talk, share, explore, work, play, and even shop on web. These activities are created by web engineers, instructional designers, game developers, etc. They however, share a common role, namely that of a web designer. Surfing around employment pages on the Internet, we often see the job title of a web designer with descriptions as follows: "performs a wide variety of professional tasks, which demand a high level of creativity and imagination, as well as a

thorough knowledge of the applicable customer needs and expectations.” We also see announcements of contract-to-hire web designers with certain requirements: “being naturally creative and imaginative”, and “design innovative interactive experiences that delight the imagination and provoke the mind”.

Howard, Culley, and Dekoninck (2008) claimed that without imagination and creativity in design there is no potential for innovation, which is where imagination is implemented and creativity is transformed into commercial value. Imagination is one of the most important cognitive capacities for learning. Perhaps in reaction to their mystifying natures, imagination was relatively neglected in twentieth-century research. There has been much less concern to offer empirical clarification of various philosophical formulations of imagination, let alone to elucidate the relationships between these formulations and creativity (Beaney, 2005). Taking these concerns into account, this study aimed at exploring what psychological and environmental variables influenced the imagination of web design university students, and the effects these variables had on their imagination.

## **Imagination**

Imagination is “a creative faculty of the mind” or “a power of the mind”, which enables people to go beyond actual experience and construct alternative possibilities in which a fragmented situation becomes a meaningful whole (Passmore, 1985; Perdue, 2003). Therefore, imagination can be viewed as the basis for cultivating creative thinking, and thus the driving force of innovation (Finke, 1996). Furthermore, Colello (2007) contended that the activities of human imagination can be classified into two different categories: reproductive imagination and creative imagination. Reproductive imagination is characterized by the ability to reproduce mental images described by others or images from less accurate reflections/recollections of reality. Creative imagination, on the other hand, emphasizes the attributes of initiation and originality.

From the related literature, several characteristics were compiled to represent human imaginative capabilities (e.g., Liang, Hsu, Chang, & Lin, 2012). These characteristics were concentration, crystallization, dialectics, effectiveness, exploration, intuition, novelty, productivity, sensibility and transformation. First, or initially, Folkmann (2010) claimed that the process of focusing lies in the span between clear and rational discourse and the inaccessible mental space, and is open to ongoing reformulation. **Concentration** thus refers to an individual’s ability to formalize ideas through focus. Second, imagination bridges “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.

Third, Cartwright and Noone (2006) also explained that imagination is what occurs as a person encounters new ideas and logically engages in confrontations, arguments, and controversies. **Dialectics** thus refers to an individual's ability to seek improvement by logically analyzing ideas. Fourth, the imagination of inventors is influenced directly by the constitution of end products and confined within certain constraints (Ribot, 1906). Shin (1994) stated that problems are resolved only as imaginative anticipation begins searching for **effective** solutions to problems.

Fifth, Valett (1983) illustrated that children **explore** the world through play, and then satisfy themselves through exaggerations of their intuitive impressions. Folkmann (2010) claimed that imagination can be seen as a structure in consciousness that negotiates, exchanges, and explores between the known and unknown. Sixth, Reichling (1990) contended that knowledge is gained directly as an insight or a grasp of the whole through **intuition**. Townsend (2003) anchored that if people utilize more intuitive representations, then their imagination would last longer.

Seventh, Beaney (2005) indicated that someone who is imaginative is good at creating new possibilities, and able to offer fresh perspectives on what is familiar. Eighth, imagination corresponds to four particular sets of conditions namely: quantity of images; quantity and intensity of images; quantity, intensity and duration of images; as well as complete systematization (Ribot, 1906). All of these evolving conditions are related to physical dimensions of imaginative **productivity**, continuity and fluency.

Ninth, inventors strive to achieve their goals and overcome problems, often experiencing painful struggles in thoughts, feelings, and emotions during creative activity (Ricoeur, 1978). Reichling (1990) also contended that most of imagination is emotive content, with an intuitively **sensible** meaning. Tenth or finally, 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**. Vygotsky (1978) stressed that this transformation enables children to learn how to control a situation through the use of symbols.

### **Influential Variables on Imagination Stimulation**

Byrne (2007) indicated that human imagination may be stimulated by psychological sources such as motivation, emotion, self-efficacy, and cognition. According to Rosenbaum (2002), people's performance at a given time is influenced by what they imagine and plan to do next. Such anticipatory effects have been treated as clues to the nature of human perceptual-motor planning.

Oettingen and Mayer (2002) also indicated that positive expectations would predict high-effort and successful performance. This form of thinking about the future is closely related to **motivation**.

Fredrickson (2001) suggested that **emotions** such as joy and love broaden a person's available repertoire of cognitions, thus enhancing creativity and imagination. Although emotions have been studied as facilitating variables in changing people's creativity and problem-solving skills (e.g. Erez, & Isen, 2002), there are conflicting studies however, that argue conversely. For example, emotions experienced during learning processing can be viewed as an unnecessary load on working memory, and it can have a negative effect on reasoning (e.g. Paas, Renkl, and Sweller, 2003).

Many studies indicated that individuals with high **self-efficacy** perceive themselves as capable of taking the necessary steps to resolve problems (e.g. Bandura, 2000). They believe and imagine that they can affect change, and have control over their thoughts and actions. They are confident in their capacities, and consider difficult tasks as challenges rather than threats. People with high self-efficacy are confident and imagine themselves able to do it!

Recent studies in the field of creative imagery revealed the **cognitive structures** and processes that are involved in creative thinking and imagination (Finke, 1996). For example, O'Connor and Aardema (2005) situated imagination within consciousness complete with its own pre-cognitive, cognitive and meta-cognitive domains. It allows us to realize how "believed-in imaginings" develop and become under some circumstances "lived-in experiences." In other words, internalization of acquired knowledge and experience is a crucial way to facilitate imagination (Valett, 1983). Many studies supported that cognitive activities are closely associated with the learner's perceptions, feelings, motivations and other ways to trigger ideas (e.g. Finke, 1996; Taylor, Pham, Rivkin, & Armor, 1998).

In the geneplore model of creative cognition, Finke (1996) claimed that the creativity of cognition would help to deliberate cognitive structures and processes involved in creative thinking and imagination. Two aspects accounted for creative thinking, a generative phase, where an individual formulates mental representations called pre-inventive structures, and an exploratory phase where those structures are adopted to establish creative ideas. When it comes to design experiences, Fukasawa believed that the true essence of design is the "Wow!" which we say later when using the object, and realize something that we did not notice before (Gotō, Sasaki, & Fukasawa, 2004). Fredrick (2007) also indicated that the most effective and creative problem-solvers engage in a process of **meta-cognition** in which they are aware of how they are thinking as they are doing the thinking.

In addition, research has shown that the environment can facilitate, modify

or hinder certain human behaviors and emotions (e.g. Strange, & Banning, 2001). Komives, and Woodard (2003) indicated that the campus environment can be divided into four dimensions: its dominant human characteristics, its physical components and design, the organizational structures that serve its purposes, and the participants' constructions of its social climates.

The **human aggregate** dimension represents the collective characteristics of people who inhabit the environment. This dimension creates features in an environment that reflect varying degrees of consistency, especially in terms of organizational culture, tradition or style (Huebner, & Lawson, 1990). Modern research (e.g. Claxton, Edwards, & Scale-Constantinou, 2006; Treadaway, 2009) also echoes the impacts of social climate and human aggregate dimensions on an individual's imagination.

The **physical** dimension of a campus consists of its natural environment (e.g., location, topography, temperature) and man-made environment (e.g., architecture, facilities, messages). 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, & Mogensen, 2004; Claxton et al., 2006).

The **organizational** 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.

Furthermore, the **social climate** dimension focuses on the subjective experiences of participants, and can be described in terms of their social climates (Strange et al., 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.

## Hypotheses

In regards to the role of meta-cognition, Deci, Connell and Ryan (1989) indicated that environmental conditions affect human cognition. Many scholars also claimed that people's motivation could be augmented by their meta-cognition (e.g., Paris, & Winograd, 1990). In addition, Fredrick (2007) suggested that the most effective problem-solvers engage in a process of meta-cognition. In his MASRL model, Efklides (2011) indicated that meta-cognition has positive relationships with both emotions and self-efficacy.

Vasquez and Buehler (2007) further found that people feel more motivated to succeed on a future task when they visualize its successful completion via a third-person. That is, recognition from third-persons (e.g., teachers, classmates) toward individuals' meta-cognition with hands-on practice can greatly motivate their imaginative tasks and creative performance. The factor analysis study done by Hsu, Liang, Chang, and Lin (2013) suggested to name this type of meta-cognition as **inspiration through action**, which refers to the examination of how participants felt regarding their imagination being influenced by meta-cognition with hands-on practice.

Web designers need to anticipate each of the user's choices and actions which require them to convert and objectify their imagination into the user's experiences. Web designers also need to understand their users' psychological activities and, in turn, incorporate those into their design strategies. Web designers often evaluate their designs with constantly-changing concepts envisaged in mind. Imagination, for web designers, is about seeing things in a new light and being able to make a difference as a result (Liang et al., 2012). Taking into account both the crucial role of meta-cognition on stimulated imagination and the practice-oriented nature of the web design, we hypothesized that **inspiration through action** plays a mediator between the influential variables and imagination. Subsequently, the following relationships were hypothesized in this study:

Hypothesis 1. Inspiration through action is positively associated with both reproductive and creative imaginations.

Hypothesis 2. Inspiration through action will mediate the effects of environmental influences and the imaginations.

Hypothesis 3. Inspiration through action will mediate the effects of psychological influences and the imaginations.

## **Method**

### **Participants and procedure**

The participants in this study were 907 university students recruited from seven major web design programs, across different regions in Taiwan. Taken the professional maturation into account, we did not include college freshmen in the census survey. Of the participants, 821 completed all the parts of this study. The majority (65%) was female; 37.5% were juniors, 32.6% were sophomores, 22.4% were seniors, and 7% were graduate students.

Upon securing participant approval at each program, the students participating in this study were asked to complete a questionnaire containing the measurements included in this report. In the questionnaire, the students were asked to determine their level of agreement with regards to each imaginative capability, and the strength of influence that each item had on their imagination.

All participation was voluntary and anonymity was guaranteed. They held the right to review the results of their responses.

In order to ensure the quality of this study, the survey in each university was conducted according to the same procedure and included the tutorial groups who were accompanied by their class instructors. Each of the survey assistants received an 8-hour training in order to ensure the quality of the investigation. In this manner, the problems participants faced when answering the questions could be resolved directly. The survey took approximately 15 minutes to complete and held either during or immediately following regular class time.

### **Measurement**

Influential variables in regards to imagination were measured using a questionnaire combined three scales. This questionnaire consisted of fifty-seven items, in which a total of ten items represented imaginative capabilities, twenty-one items represented environmental influences, and twenty-six items represented psychological influences. Both the internal and external validities of these variables are well documented in the literature (e.g., Chen, Huang, & Liang, 2012; Hsu et al., 2013; Liang et al., 2012).

**Imaginative capability.** Based on Liang et al. (2012), the measure for imaginative capability 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**), "I often help myself imagine by arousing personal feelings" (refers to **sensibility**), and "I am good at seeking improvement by logically analyzing ideas" (refers to **dialectics**).

**Environmental influences.** Based on Chen et al. (2012), environmental influences were measured with a 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**), "Dynamic audiovisual stimuli such as rhythm, sound, and movies" (refers to **learning resources**), "Teacher's encouragement and praise for taking risk" (refers to **organizational measure**), "Communication and discussion with classmates" (refers to **social climate**), and "There is a culture on campus of putting imagination into practice" (refers to **human aggregate**).

**Psychological influences.** Based on Hsu et al. (2013), psychological influences were measured with a scale which was composed of six subscales namely: intrinsic motivation, generative cognition, positive emotion, negative emotion, inspiration through action, and self-efficacy. Respondents rated themselves on a six-point scale ranging from 1 = strongly disagree, to 6 = strongly agree. “Courage to present different ideas” was a representative item for **intrinsic motivation**; “Use immersive sensory exploration to spark imagination” was a representative item for **generative cognition**; “Joyfulness from the surroundings” was a representative item for **positive emotion**; “Anxiety felt by individuals” was a representative item for **negative emotion**; “Be determined to achieve set standards” was a representative item for **self-efficacy**; and “Hands-on design with constantly-changing concepts envisaged in mind” was a representative item for **inspiration through action**.

## Results

### Descriptive analysis

The data were analyzed using SPSS version 17.0 software. In Table 1, the results of descriptive analysis, with regard to the means, the standard deviations, the Cronbach’s  $\alpha$  values and the correlation among variables, are illustrated.

**Table 1 The *M*, *SD*, Cronbach’s  $\alpha$ , and Correlation among Variables**

Variables	<i>M</i>	<i>SD</i>	$\alpha$	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Reproductive imagination	4.35	0.75	.82	--												
2. Creative imagination	4.30	0.69	.89	.65*	--											
3. Physical component	4.45	0.68	.78	.13*	.14*	--										
4. Learning resources	4.64	0.81	.81	.17*	.11*	.45*	--									
5. Organizational measure	4.88	0.79	.83	.19*	.16*	.42*	.48*	--								
6. Social climate	5.34	0.63	.82	.14*	.12*	.34*	.38*	.55*	--							
7. Human aggregate	4.52	0.89	.85	.16*	.15*	.29*	.42*	.50*	.46*	--						
8. Generative cognition	4.81	0.78	.82	.23*	.29*	.37*	.35*	.37*	.39*	.31*	--					
9. Intrinsic motivation	5.20	0.77	.78	.30*	.30*	.34*	.36*	.43*	.53*	.35*	.50*	--				
10. Positive emotion	4.95	0.81	.84	.11*	.12*	.28*	.28*	.39*	.35*	.33*	.39*	.45*	--			
11. Negative emotion	4.69	0.97	.90	-.04	-.02	.13*	.12*	.27*	.26*	.28*	.24*	.24*	.34*	--		
12. Inspiration through action	5.02	0.75	.83	.29*	.28*	.30*	.34*	.41*	.43*	.34*	.53*	.63*	.45*	.28*	--	
13. Self-efficacy	5.02	0.67	.85	.27*	.23*	.33*	.31*	.42*	.45*	.37*	.44*	.57*	.42*	.33*	.54*	--

\* $p < .05$ .

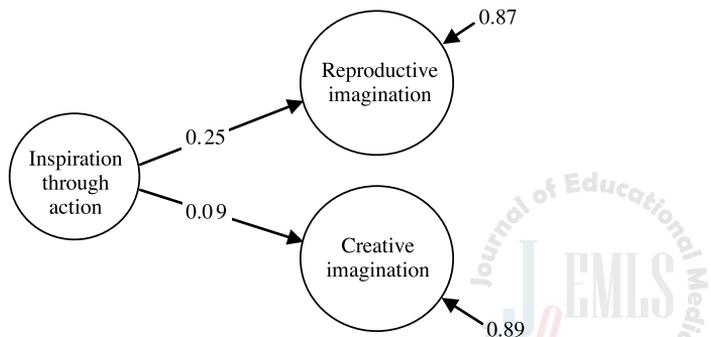
### Hypothesis testing

Confirmatory factor analysis (CFA) with maximum likelihood estimator was performed with LISREL 8.80 to determine and test the most appropriate structure of the scales. We used the following indicators recommended by Hu and Bentler (1999) and Tabachnick and Fidell (2001) to assess goodness of model fit: Comparative Fit Index (CFI; .95 or above indicating excellent fit, .90-.95 indicating an acceptable fit), Root-Mean-Square Error of Approximation

(RMSEA; .05 or below indicating excellent fit, .05-.08 indicating an acceptable fit), Standardized Root Mean Squared Residual (SRMR; .05 or below indicating excellent fit, .05-.08 indicating an acceptable fit), Tucker-Lewis Index (TLI; .95 or above indicating excellent fit, .90-.95 indicating an acceptable fit).

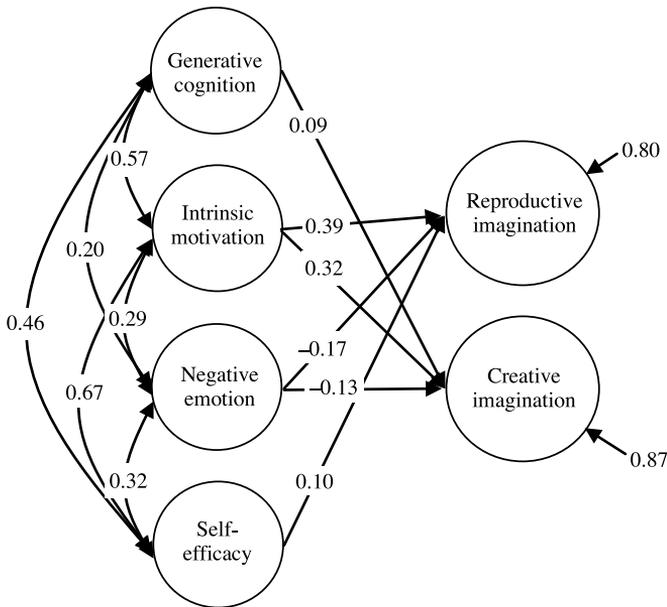
The results of this CFA showed that the thirteen-factor solution (two-factor imaginative capability, five-factor environmental influences, and six-factor psychological influences) yielded acceptable fit for this study ( $\chi^2 = 3790.36$ ,  $df = 1461$ ,  $p < .005$ , CFI = .97, RMSEA = .047, SRMR = .047, TLI = .96). In regards to the measurement of imaginative capabilities, the factor loadings ranged from .52 to .80, the values of construct reliability ranged from .77 to .85, and the measurement errors ranged from .35 to .70. In regards to the measurement of environmental influences, the factor loadings ranged from .53 to .92, the values of construct reliability ranged from .76 to .91, and the measurement errors ranged from .16 to .72. In regards to the measurement of psychological influences, the factor loadings ranged from .60 to .96, the values of construct reliability ranged from .84 to .94, and the measurement errors ranged from .08 to .65. The results indicated that construct reliability, external and internal validities were also achieved.

The present hypotheses suggested that three sets of variables (inspiration through action, environmental influences, and psychological influences) stimulate imagination, and that **inspiration through action** mediates the effects of the other two clusters of variables on imagination. According to these hypotheses, we first examined the effects of the mediator (**inspiration through action**) on both reproductive imagination and creative imagination. As Figure 1 illustrated, our data showed a good fit to the present data ( $\chi^2 = 301.90$ ,  $df = 74$ ,  $p < .005$ , CFI = .97, RMSEA = .060, SRMR = .045, TLI = .97). Each of the standardized path coefficients reached the significance level ( $p < .05$ ).



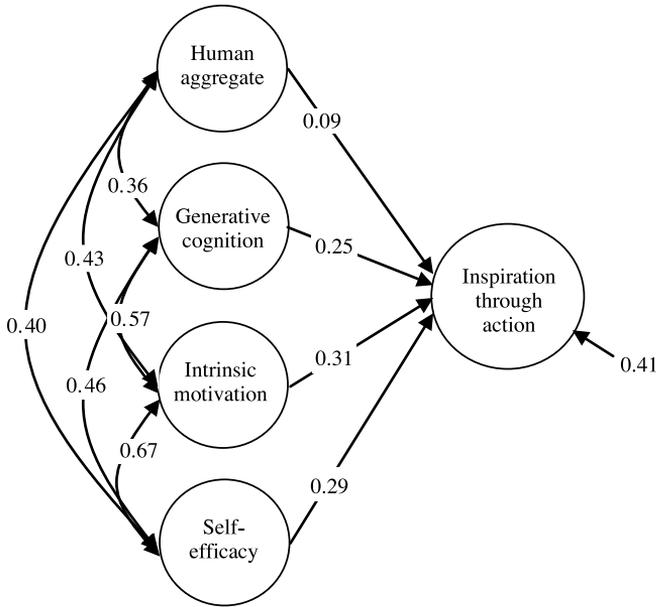
**Fig. 1 The Effects of Inspiration through Action on the Imagination**

We then tested the effects of the influential variables on both reproductive imagination and creative imagination. The results of this analysis showed a good fit to our data ( $\chi^2 = 3283.21$ ,  $df = 1259$ ,  $p < .005$ , CFI = .97, RMSEA = .048, SRMR = .049, TLI = .97), but not all analyzed variables were significantly associated with imagination. We then removed the non-significant paths, and revised the model. In the revised model (refer to Figure 2), only the four significant paths respectively, **generative cognition**, **intrinsic motivation**, **negative emotion**, and **self-efficacy** to imagination were kept ( $\chi^2 = 1532.51$ ,  $df = 364$ ,  $p < .005$ , CFI = .95, RMSEA = .067, SRMR = .058, TLI = .96). Each of the coefficients reached the significance level ( $p < .05$ ).



**Fig. 2 The Effects of Influential Variables on the Imagination**

We continually examined the effects of the influential variables on the mediator. The results of this analysis showed a good fit to our data ( $\chi^2 = 2934.12$ ,  $df = 979$ ,  $p < .005$ , CFI = .97, RMSEA = .052, SRMR = .049, TLI = .97), but not all variables were significantly associated with the mediator. We then removed the non-significant paths, and revised the model. In the revised model (refer to Figure 3), only the four significant paths respectively, **human aggregate**, **generative cognition**, **intrinsic motivation**, and **self-efficacy** to the mediator were kept ( $\chi^2 = 1302.35$ ,  $df = 242$ ,  $p < .005$ , CFI = .96, RMSEA = .072, SRMR = .055, TLI = .96). Each of the coefficients reached the significance level ( $p < .05$ ).

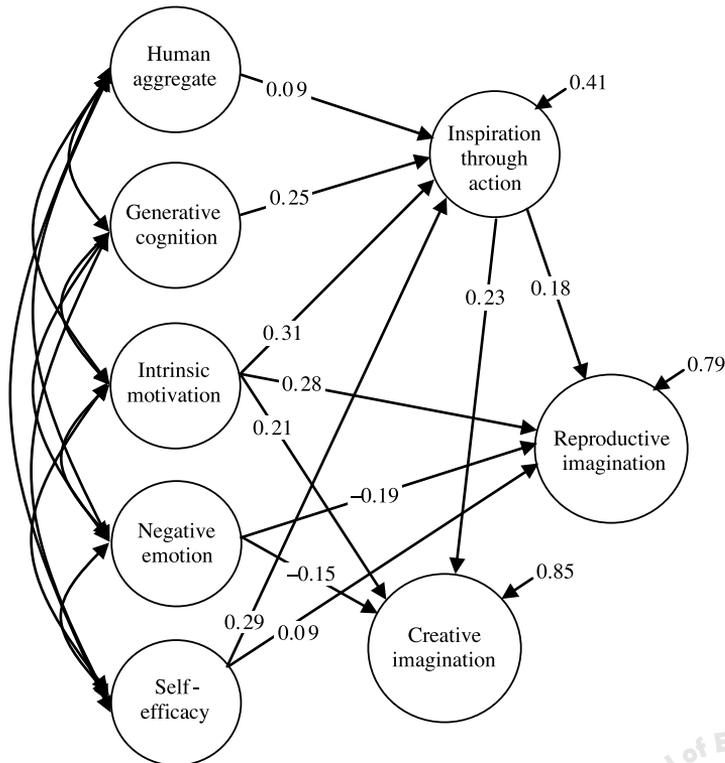


**Fig. 3 The Effects of Influential Variables on the Mediator**

We then proposed a partial mediation model. In this model, **inspiration through action** would mediate the influences of these variables on both reproductive imagination and creative imagination. Although the initial model ( $\chi^2 = 2045.56, df = 601, p < .005, CFI = .97, RMSEA = .055, SRMR = .048, TLI = .97$ ) showed a good fit to the present data, not all variables were significantly associated with two kinds of imagination. We decided to remove the non-significant paths and then revise the structural model. In the final model, only the four paths respectively, **human aggregate**, **generative cognition**, **intrinsic motivation**, and **self-efficacy** to the mediator (**inspiration through action**) were kept. In addition, the influences of **negative emotion** on both reproductive imagination and creative imagination were significant, and thus these paths were also retained.

This final model showed a model fit comparable to that of the initial model,  $\chi^2 = 2003.19, df = 607, p < .005, CFI = .97, RMSEA = .055, SRMR = .049, TLI = .97$ . It accounted for substantial variance in **inspiration through action** ( $R^2 = .59$ ), **reproductive imagination** ( $R^2 = .21$ ) and **creative imagination** ( $R^2 = .15$ ). The standardized path coefficient of **inspiration through action** (the mediator) to reproductive imagination reached .18, and the path of **inspiration through action** to creative imagination reached .23. Each of the coefficients reached the significance level ( $p < .05$ ).

With regard to independent variables, our results showed that **human aggregate** had indirect effects on reproductive imagination (.0162) and creative imagination (.0207). Similarly, **generative cognition** also had indirect effects on reproductive imagination (.045) and creative imagination (.0575). **Intrinsic motivation** contained both direct and indirect effects on imagination. Its direct effect on reproductive imagination was .28, and the direct effect on creative imagination was .21. At the same time, the indirect effects resulted from **intrinsic motivation** on reproductive imagination reached .0558 and on creative imagination reached .0713. Although **negative emotion** had no indirect effect on imagination, it had direct effects on both reproductive imagination (-.19) and creative imagination (-.15). Lastly, **self-efficacy** had both direct (.09) and indirect (.0522) effects on reproductive imagination, and this variable only had an indirect (.0667) effect on creative imagination.



**Fig. 4 Structural Model Depicting Inspiration Through Action as Mediator of Influential Variables and Imagination**

The case of model trimming suggested that the final model is a more presentable model, and hence, should be supported. Overall, the SEM results summarized in Figure 4 partially support the present hypotheses. **Inspiration through action** directly influenced imagination (Hypothesis 1 was supported).

Partially confirming the mediating hypotheses (Hypothesis 2 and 3), one environmental variable (**human aggregate**) and three psychological variables (**generative cognition**, **intrinsic motivation**, and **self-efficacy**) influenced imagination through their impacts on inspiration through action. **Negative emotion** retained its direct effects on imagination. The correlation of latent independent variables reports in Table 2.

**Table 2 The Correlation of Latent Independent Variables**

Variables	1.	2.	3.	4.	5.
1. Human aggregate	--				
2. Generative cognition	.36	--			
3. Intrinsic motivation	.43	.57	--		
4. Negative emotion	.27	.20	.29	--	
5. Self-efficacy	.40	.46	.67	.33	--

## Discussion

While philosophical studies abound on the influences of external environment and internal cognition on imagination development, little research articulates about imaginative capabilities, nor the variables that may affect these capabilities. The results of the current study supported that human imagination could be categorized into two groups. First, reproductive imagination consisted of crystallization, dialectics, effectiveness and transformation. Second, creative imagination consisted of exploration, focusing, intuition, novelty, productivity and sensibility. In no way definitive or exhaustive, nonetheless, the study has yielded a path for further inquiries.

In addition, this study proposed and examined a mediator model of **inspiration through action** in which psychological and environmental variables, both directly and indirectly influenced the creative and reproductive imaginations of web design students. Our findings supported that this mediator effect results from **inspiration through action**. No matter what forms of inspiration were kindled during the production process, or evaluation of semi-products with constantly-changing concepts envisaged in the mind, **inspiration through action** proved to be a key to triggering student imagination, especially the creative one. Our results also showed that **intrinsic motivation**, **self-efficacy**, **generative cognition**, and **human aggregate** had their influences on imagination through this mediator. These findings imply that researchers and instructors may need to focus more on understanding the mediator effects and the applications of meta-cognitive tools.

Although the results supported the mediator role of **inspiration through action**, we wonder if any other mediators exist in this vein? What if **intrinsic**

**motivation** or **self-efficacy** becomes a mediator, what then? What if there are double or even triple mediators, what then? Furthermore, do any moderators or non-linear relationships exist among the variables discussed in the present study? In addition, since different academic standings of web design students (i.e., sophomores, juniors, seniors, and graduate students) represent different levels of professional maturation, the future studies may need to focus on the differences resulting from different academic standings. Much more work needs to be done in order to shed light on this issue of mediation.

With respect to **human aggregate**, our results showed that this variable had slight but significant effects on both reproductive and creative imaginations. These effects were indirect and functioned through the mediator of **inspiration through action**. As the final model indicated, similar to human aggregate, **generative cognition** also contained only indirect effects on both imaginations. Elaborating on these findings, the issue would become how to incorporate institutional culture and various thinking skills into meta-cognitive strategies (e.g. Claxton et al., 2006; O'Connor et al., 2005). There are few academic discussions around this issue in the field of web design, which underlines a demand for more efforts to be devoted to this research in the future.

In addition, the current study highlights the critical role of **intrinsic motivation**. The motivation variable not only greatly contributed to the mediator effects, but also strongly impacted both reproductive and creative imaginations. Scholars have long argued that people are likely to be creative when they experience high levels of intrinsic motivation (e.g., Amabile, 1996), since such motivation increases their tendency to be curious, cognitively flexible, and risk taking (e.g., Utman, 1997; Zhou, & Shalley, 2003). Although creativity is different from imagination (Robinson, & Aronica, 2009), many scholars agree that imagination serves as the vehicle of active creativity (e.g., Gaut, 2003). The current study extends the argument to the potential effects of **intrinsic motivation** on imagination.

With regard to **self-efficacy**, our findings showed that this variable had an indirect effect on both imaginations, and a direct effect on reproductive imagination. These findings lend additional supports to the influence of self-confidence on positive expectation in problem-solving (Bandura, 2000). According to the results, learners' belief in their own competence to accomplish the assigned tasks greatly contributed to their meta-cognition with hands-on practice, and in turn, meta-cognition facilitated student imagination. How to increase learner's self-efficacy, while maintaining the necessary task-complexity at the same time, becomes a critical issue for web design education.

Interestingly, **negative emotion** had no significant impact on the mediator of

inspiration through action, but had direct effects on both reproductive and creative imaginations. These results indicated that an individual's negative psychological state and the surroundings could be viewed as an unnecessary load on the thinking process, which is consistent with earlier studies in this topic (e.g. Paas et al., 2003). However, we are aware that negative emotion can also be used to derive enormous creative energy for some genius artists and scientists (Amada, 1999). Bearing in mind the opposite-sided influences brought from negative emotion, future inquiries may test the moderating or non-linear effects caused by this variable.

In respect to reproductive imagination, our findings showed that this type of imagination would be greatly influenced by the learner's motivation, especially the driving forces such as interesting assignments and positive expectations (e.g. Oettingen et al., 2002). Self-confidence in regards to personal ability seemed to play a facilitative role to enhance intrinsic motivation, which echoes Bandura's series works. Without an indirect effect, **negative emotion** directly but negatively influenced reproductive imagination. **Inspiration through action** was positively associated with this type of imagination. Thus, to improve the student reproductive imagination, it may be important to use the following strategy: promote intrinsic motivation as the main approach, enhancing with inspiration through action and self-efficacy, while avoiding the arousal of negative emotion.

In regard to creative imagination, our results indicated that this type of imagination in the web design field would be greatly influenced by the learner's meta-cognition with hands-on practice. **Intrinsic motivation** here still plays a crucial role in contributing to imagination-stimulation. **Negative emotion** remained a direct but negative impact on creative imagination. These results may suggest that strategies of **inspiration through action** paired with **intrinsic motivation** should be embedded in learning activities in order to trigger the student creative imagination. This also suggests that instructors should be adept at recognizing negative emotions while encouraging and intervening to change students' affective states whenever possible.

### Limitations and Closing Remarks

There are a couple of limitations in the current study. First, the final model fits the data well, but the predictive validity could be stronger. This result may be due to the high correlations between some of the variables. Another inference similar to multiple influential variables on human creativity, is that both psychological and environmental influences are but two variables stimulating learners' imagination. Additional variables, such as learner's personality and ethnicity, should be taken into future account.

A second limitation is the use of self-reported influence. This choice however, was justified by the preliminary nature of the study. The questions asked in our study did not include sensitive items that would cause the respondents to present themselves in a more socially acceptable manner. The results of our pilot study were consistent with the current study, indicating that the factor structure of our measure is stable across sample groups and did not seem to suffer from self-report bias. In addition, using self-report surveys enables us to study large samples of students. In the current study, we had nearly a thousand students participate and our samples were large enough across universities allowing us to generalize our findings to a larger population.

Although the limitations of this study must be kept in mind, the results reported here provide intriguing insights into the complexities of human imagination. In addition to having a remarkable depth for creativity and a mastery of computer applications, web designers are commonly required to be outstanding communicators with exceptional imaginations. Clients often find it difficult to verbalize their needs. Web designers are required to ask pointed questions and imagine their visions. Imagination, for web designers, is about seeing things in a new light and being able to make a difference as a result. Web designers need to anticipate each of the user's choices and actions which require them to convert and objectify their imagination into the user's experiences.

How can we, as web designers, sympathize with users' needs and feelings in cyberspace? How can we understand their psychological activities and, in turn, incorporate those into our design strategies? How can we equip ourselves with sufficient imagination capacity? 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. We sincerely wish that the utilization of this study will in turn, inspire the construction of appropriate instructional strategies to assist students and develop their imagination.

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# 多媒體學生的想像促發： 做中悟的中介效果

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## 摘要

本研究旨在分析何種心理與環境因素會促發多媒體(網站)設計系所學生的想像，以及這些因素的影響效果。調查研究橫跨臺灣各地共七所大學院校，有效樣本共計821份。研究結果驗證想像具有：專注、具象、辯證、有效、探索、直覺、新穎、生產、感受和轉用等十個能力特徵。影響想像的心理因素可分為六個構念：生產性認知、內在動機、正向情緒、負向情緒、自我效能，與做中悟。影響想像的環境因素可分為五個構念：物理環境、學習資源、組織措施、社會氣氛，及文化特質。本研究以做中悟為中介的假設模型，獲得部分支持。結構方程模型顯示，文化特質、生產性認知、內在動機、負向情緒，和自我效能等因素，對想像力具有顯著的間接效果。人才培育、後續研究與研究限制等均有所討論。

**關鍵詞：**環境影響，想像，做中悟，中介效果，心理影響