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Curiosity and Design Education

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Abstract

Design education centers and their teachers know that not all users are equal in their needs or interests. User-centered approaches help, within the design process to meet needs, requirements and expectations to enhance the range and acceptance of products (Altay, 2014; Zoltowski, Oakes & Cardella, 2012). To meet this aim, in teaching, different research strategies are imparted for identifying those outcomes that, beyond functionality, includes other variables to the product's experience. These strategies share a common aim: to identify by direct contact features that if consider, may enhance the resultant product (Altay, 2014.). This kind of formation is usually included in the learner-centered instruction; and is useful when the students expand their knowledge in the needed data and use it for the intended aim. Programs that teaches the students to develop their natural abilities to help them "think on" design instead of solving specific design problems (Gorgul & Gorgul, 2012) are a reality. And, while as an environment it promotes learning through experimentation as the perfect medium to grow students as innovators; they usually are not designed considering the personal characteristics and traits that may also be needed to be counted to better comprehend how does previous conditions to education are related to the intended individualistic redesign of curricula. The purpose of this proposal is to investigate personal curiosity as an underlying condition to innovation and design education that may alter the results of a design methodology intended to improve the students´ project-based learning. For this correlational study participants were recruited from Technology Exploration & Design, and Analysis of Mechanisms courses, using a convinience sampling method. Respondents were required to complete two rating scales, one assessing curiosity as a trait and the other assessing their creativity style.

Keywords: curiosity; design ; education.

1. Introduction

A worldwide response to global economy setbacks had been described as the necessity to innovate (Tekin & Faruk, 2015). Innovation, or the application of new creative ideas to improve inventions (Satell, 2017) is a major concern in design's educational curricula. Through the time, different process and methodologies had been develop in respond to it. Considering that each process centered in human cognitive, and motivation capacities, entangles the necessity of knowing which variables contribute to it state, this research was developed to scrutinize curiosity and its relationship to the design process as part of a new methodology proposal.

1.1 Teaching methods to be creative

Now days, it is undeniable that creativity comes with benefits to any field and that innovation is a worldwide necessity to give response to a variety of problems. To increase the capacity to solve educational and real-life problematics is a hard work to do which involves finding, and implementing what is most effective to meet these purposes. While enhance creativity, the ability to produce new and convenient work (Sternberg & Lubart, 1999), is an important concept that trespasses disciplines; few of them develops educational curricula aimed to enhance it and promoted it on regular basis.

It is recent that design education had actively try to converge both, real life problems with curricula as its core principle (Gorgul & Gorgul, 2012). To this day, teaching methods tend to balance both, the creative process with a critical awareness of objective criteria to meet the design purposes. Regularly, in these programs, design curricula consider aspects as learning styles as individual traits with an active repercussion in the student's outcomes (Yalçin, 2015). But what other sources of variability do we have? Creativity is not an one stand variable or solitary construct. And even when educational goals tend to focus on it to improve design solutions, other aspects as cognitive skills, personality traits, interests and tenacity at work; while tend to be seem as unlikely to change by working in university courses, do have an impact in those outcomes (Daly, Mosyjowski & Seifert, 2014).

1.2 Viewing creativity and innovation from a psychological standpoint a small overview

Creativity is necessary to discover and solve problems, it is necessary to innovate, and for reconcile contradictions to get better results (Daly et al., 2014). Research shows that every person may be educated to be creative, but potentially, only those whom believe so, do creative things (Da Via, McCoach & Siegle, 2013).

Culture, the shared knowledge and understandings about the world, matters both in creativity and in innovation. While building an environment for experimentation and risk-taking had being highlight as an important step for allowing innovation, not every culture -whether national or pertaining to a small group- considers these characteristics as essential to cultivate in their work force (Tekin & Faruk, 2015).

Open-ended projects, whether involving or not real-life problems, permits to the students to both, work the project and the metacognitive skills that helps them improve their creative abilities; yet as Daly et al. (2014) found, in engineering programs it is rarely intended to include activities that improve the alumni abilities for seeing relationships or solving ambiguity between concepts, to be open for exploring new ideas or enhancing their capacity to tolerate ambiguity. All of them, necessary to work both in creative and innovative ways.

1.3 The present research

According to Wagner & Jain (2014) curiosity, or the passion for solving technical problems with a deep appreciation of the environment, is a necessary trait for companies were leading technology is their main objective. In educational settings, design curricula tend to nurture the innovative mind with knowledge, accumulating and cultivating the abilities of the future breakthrough professionals. Programs teaches the students to develop their natural abilities to help them "think on" design, instead of solving specific design problems (Gorgul & Gorgul, 2012). Thus, aimed to help them develop their natural abilities to make the right design decisions, this programs' environment tends to promote learning while experimenting and observing, considering that variables as learning styles may have an effect in the outcomes (Yalçin, 2015). But leaving aside other personal characteristics that are actual core elements to design and innovative performance, as curiosity.

Curiosity is a trait and may be defined as the willingness to recognize, embrace and seek out for knowledge and new experiences (Kashdan et al., 2009). Curious people tend to accumulate experiences, knowledge and abilities but only if the effectively cope with the novelty, ambiguity and uncertainly of their own explorations (Kashdan et al., 2009; MacKinnon, 1978). Regarding these features, curious people involved in design problems are expected to make more creative or innovative efforts if they have this ability to cope or make sense of new stimuli. Thus, the purpose of this proposal is to investigate personal curiosity as an underlying condition to innovation and design education that may alter the results of a design methodology intended to improve the students´ project-based learning.

1.3.1 Research goal

As presented before, the overall goal of this study was to investigate personal curiosity as an underlying condition to innovation and design education that may alter the results of a design methodology intended to improve the students´ project-based learning. To meet these purpose, which is part of a major research project, two sub goals were investigate in this project (1) to identify at what extent curiosity dimensions as stretching and embracing relates to the creativity style of alumni and (2) to look for differences within the sample regarding the gender, a demographic variable that is not always included in design or engineering creativity education research but tend to have an impact in personality research.

2. Method

For this correlational study participants were recruited from Technology Exploration & Design, and Analysis of Mechanisms courses, using a convenience sampling method. Respondents were required to complete two rating scales, one assessing curiosity as a trait and the other assessing their creativity style. All responses were gather voluntary and anonymously.

2.2 Participants

The participants in this study were 5 women (23.8%) and 16 men (76.2%), whom had previously participated in a design course aimed to revise the effectivity of a new design method. All of them were engineer students by the time this research project was conducted.

2.3 Instruments

Measure

The creativity test selected was the Creativity Styles Questionnaire-Revised (CSQ-R). The CSQ-R consists of 8 scales and uses a 5-point Likert-type scoring from Strongly-agree (1) to Strongly-disagree (5). Three subscales were selected for this study: Use of techniques; Environmental Control/ Behavioral Self-regulation and Use of the senses. Also, the first 2 items corresponding to the measurement of the global creativity capacity. This sample reliability values are presented in Table 1. Individual goals of this subscales include:

a) Use of techniques. Measure the uses of specific strategies or techniques to facilitate the creative work

b) Environmental Control/ Behavioral Self-regulation. It presents the extent to which a person sets up discriminative stimuli to facilitate the creative work.

c) Use of the senses. Measure the extent to which a person uses the 5 senses for creative work.

Regarding curiosity, we used the Curiosity and Exploration Inventory-II (CEI-II; Kashdan et al., 2009). This inventory includes two subscales, one measuring the motivation to seek new experiences and knowledge (streching); and the other related to the willingness to embrace the novel, uncertain and unpredictable (embracing). This scale uses a 5 points Likert-type scoring from Very slightly or not at all (1) to Extremely (5). Its reliability values are also presented in Table 1.

2.4 Procedure

For this research students from a previous research project (New Product development; the Nikola Tesla extrapolation, DOI: 10.1109/ICASI.2017.7988129) were contacted via e-mail and asked to participate in an online survey. While all the students involved in the previous project were invited, only those belonging to the engineering career answered the questions.

2.5 Statistical Analysis

Reliability of the inventories was analyzed via Cronbach's alpha. We calculated means and standard deviation of each demographic variable. The main analyses concerned two outcomes: (1) the relationship between the creative style and the curiosity value; (2) the differences regarding the gender of the participants. Using a Pearson correlation, we assessed the relationship between creativity and curiosity; we compared sexes through a T test.

3. Results

Table 1 contains the subscales and scales reliabilities, as well as their means and standard deviations. The reliability of the subscales and scales ranged from .71 to .98, so each of them exceeded the minimum recommended reliability of .70.

Table 1. Reliabilities, mean and standard deviations of scales and subscales.

	Alpha reliability	**Mean**	**Standard Deviation**

	(all items)		
Creativity Styles Questionnaire-Revised (CSQ-R)	.77	87.00	11.34
Use of techniques	.71	40.71	7.41
Environmental Control/ Behavioral Self-regulation	.73	31.80	4.78
Use of the senses	.75	14.48	3.9
Curiosity and exploration Inventory (CEI-II)	.98	23.90	18.01
Streching	.97	12.80	9.56
Embracing	.96	11.09	8.53

Pearson coefficients of correlation performed between the three creativity styles subscales and the two curiosity subscales are presented in Table 2. As indicated, a negative and significant correlation was obtained between the student's environmental control/behavioral self-regulation ability and their capacity for embracing novel and novel and uncertain stimuli.

Table 2. Correlations among the subscales of CSQ-R and CEI-II

	Streching	Embracing
Use of techniques	-.113	-.190
Environmental Control/ Behavioral Self-regulation	-.374	**-.518***
Use of the senses	-.201	-.220

* Significant at the .05 level

Lastly, the independent sample t test analysis performed between men and women subsamples. This analysis permitted us to know that all the values of the CEI-II inventory exhibited statistically significant differences in which women presented a higher tendency to explore, to be receptive and accept ambiguous stimuli than men. In their overall curiosity's value women also presented a greater punctuation.

Table 3. Sample t test analysis performed between men and women subsamples

		Mean	Standard Deviation	T Test
streching	women	19.40	2.19	t(21)=3.19, p=.005
	men	10.75	10.08	
embracing	women	17.00	1.00	t(19)= 3.36, p=.004
	men	9.25	9.03	
curiosity	women	36.40	3.13	T(19)= 3.308, p=.004
	men	20.00	19.02	

4. Discussion

Everyone may be educated to be creative (Da Via, McCoach & Siegle, 2013); and current programs intend to teach the students how to develop their natural abilities for "think on" design (Gorgul & Gorgul, 2012). To meet these purposes classroom activities brings real world problematics for being solve, allowing the alumni to observe and experiment in environments that consider differences as their learning styles (Yalçin, 2015). Although these programs have a positive and significant impact in the way the students perceived and solve real world problems, research had found that some aspects related to their creative endeavor may be

missing in the educational curricula by not considering variables and traits entangled to creativity and innovation, as curiosity does.

How do individual factors related to creativity and innovation have an impact in the creative styles and responses to design or engineer problematics? The aim of this study was to investigate personal curiosity as an underlying condition to innovation and design education, as part of a major project focused in a new design methodology that intend to improve the students´ project-based learning. For reaching our purposes, two specifics aim were target: a) to identify at what extent curiosity dimensions, as stretching and embracing, relates to the creativity style of alumni and; b) to look for differences within the sample regarding the gender, a demographic variable that tend to have an impact in personality traits' research.

In this research, we found a negative and medium correlation between the environmental subscale and the stretching subscale, indicating that, those students whom evaluate their creative style as related to a better discrimination of stimuli that seems to facilitate their creative work, tend to present less motivation to seek for new experiences and/or knowledge as a personal curiosity trait. This evidence suggests at the least, that those whom discriminate the best, have better chances to find better solutions; or that at least they'll tend to research more. For educational purposes, this finding has relevance in creative/design or engineer curricula since, as founded by Daily et al. (2014), while this cognitive aspect describes curiosity and is presented as a metacognitive skill necessary for creativity and innovative formation, it is rarely included and assessed in those programs.

Beyond the responses toward curiosity and its relationship with the creative styles, this sample also provide insight to a lesser extent, of differences regarding the sex of the participants in the curiosity measure. To our knowledge, no previous research have included gender differences regarding creativity and curiosity in educational settings were solving creative problems are the main target. Thus, this result provide evidence for further exploration in this area.

A limitation to this study is that all participants decided to donate their time to this research; the presence of only self-selected people underestimated the possibility to compare this data with those of people uninterested in participate; and our sample is small, and unrepresentative of the engineer and design student population.

In resume, not only creativity relates to the creative or innovative outcomes in educational settings. Other variables, personal traits of the students as curiosity, may have an impact in their choices and solutions; which may be targeted in the curricula by incorporating activities and assessments focused on them as specific skills to improve.

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