CREATIVE THINKING IN ARCHITECTURAL DESIGN EDUCATION

Ayla Ayyıldız Potur*, Ömür Barkul*
**Faculty of Architecture, Yıldız Technical University, Turkey*
aylaayyildiz@yahoo.com, barkul@yildiz.edu.tr

ABSTRACT

Creativity is an original cognitive ability and problem solving process which enables individuals to use their intelligence in a way that is unique and directed toward coming up with a product. The most common means of identifying creativity has been through its products. The arts including sculpture, painting, and the humanities including writing, law are not only areas in which human creativity has been exhibited. Science and engineering fields are also full of discoveries and products that meet our tests of creativity. Today, there is a need for measuring creativity in different fields of disciplines and professions such as personnel selection, education and fine arts. Architectural education is one of them because, it can be defined as *a design study which get it's origins from creativity*. While the encouragement and rewarding of creativity is very important in all fields, it is especially important in the field of architectural education.

The objective of this paper is to investigate creative thinking standards of architectural design students and to test the effectiveness of architectural design education on the improvement of general creative thinking abilities. In order to accomplish this, two sample groups are formed from different levels of education. The main method used in this research is TTCT which was first published in the USA. The test measures verbal - visual creativity and has reliability - validity studies. In the conclusion of the paper, a discussion has been made on relationship between the general creative thinking ability and architectural education.

Keywords: Creative Thinking, Architectural Creativity, Architectural Education, Creativity Measurement, TTCT (Torrance Tests of Creative Thinking)

INTRODUCTION

Architecture is an un-revealed collaboration of technique and aesthetic. Technique is the grammar of the architectural language and the creativity discloses the

real precious of technique as well. When we describe an architectural work as *a work of art*, this also includes the word *creativity* (Nervi & Ricken, 1990). It's possible to increase these definitions which stressed the correlation between architecture and creativity. When we consider architecture as a multidimensional, comprehensive discipline, we also appropriate that it implies both art and profession.

Architecture has much in common with other disciplines: social sciences, management, history, operational research, philosophy, graphic design, math and etc. These features which distinguish architecture from other disciplines impute different kind of responsibilities for architectural education. Besides technical and professional skills, an architect must have imagination and to be creative at many levels, and must gain artistic and intellectual ability as well. This matter gains much more importance in some countries, like Turkey. The keywords of creative thinking should be summarized as critical thinking, divergent cognitive style, heuristic search, holistic approach, lateral thinking etc. All of these keywords are not considered in the important objectives of primary, secondary and high school education in Turkey. With the model of *frontal classroom teaching* students are not able to connect the new information to a meaningful context and the situations in actual practice. Architectural students who met with the innovative educational methods such as *learning by doing*, *project teaching*, *student centered learning*, *problem based learning (PBL)* at the first time, are really not ready to the new forms of the design knowledge. Design ability also relies fundamentally on non-verbal media of thought and communication. This lack of main principles becomes more important when the process of entrance to university in Turkey is considered. Students, who applied to an architectural program, do not have any special exam and aptitude test for measuring their ability on *creativity* and *efficiency*. Therefore, in this research it is aimed to find out these questions: *Can we measure the creativity of architectural students at the beginning of the architectural education with TTCT?* and *Is it possible to test the effectiveness of architectural education on the improvement of general creative thinking abilities?* In this case, before explaining the case study, the theoretical framework will be discussed in general manner.

THEORETICAL FRAMEWORK

Creativity is multidimensional subject which is still not completely understood by psychologists yet. Philosophers, social critics, artists, architects, etc., have developed theories of creative thinking at least from the time of Plato and until today (Adams, 1998). Torrance (1974) defined creativity as "a process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; identifying the difficulty; searching for solutions, mak-

ing guesses, or formulating hypotheses about the deficiencies: testing and retesting these hypotheses and possibly modifying and retesting them; and finally communicating the results." Creativity is often considered as the ability to generate ideas that are both innovative and functional. MacKinnon sees creativity as a combination of arts, sciences and technology (Broadbent, 1975).

The Phenomenon of Architectural Creativity

Architecture is the art and technique of designing the enclosure of space for human use, as distinguished from skills associated with construction. As with some other arts, the development and practice of architecture embraces both aesthetic and utilitarian ends; these ends may be distinguished from each other but not separated completely, furthermore, the relative weight given to each end, purpose, or motif, may vary widely from one architectural project or work of art to another. Although creativity and creative thought can be applied just as much in science, philosophy, the law, management and many other fields of human endeavor, according to Lawson (1997), most people would describe design as one of the most creative of human pursuits. Some researchers see design as the process of creative problem solving and they use the words *design* and *creative problem solving* interchangeably (Willem, 1990).

Creative Thinking in Architectural Design Education

Architectural design is one kind of problem solving which primarily involves a series of actions that must be performed in order to solve a design problem (Chan, 1990). Schön (1983) identified that learning in design studio begins with ill-defined problems. The teaching method employed in design studios has a long tradition in architectural education and has been held up as an exemplar for teaching in other disciplines (Boyer & Mitgang, 1996). Schön also noted that the studio-teaching method could be generalized to all professional education. According to objectives of architectural education, students should be educated not only to gain theoretical knowledge, but also to transform this knowledge with their creativity to the actual practice. Goldschmidt and Weil (1998) suggested that design is based on acquiring skills, practice and experience. It is understood as an outcome of thinking processes. The architectural designer is thinking of the whole range of design criteria and requirements such as the aesthetic and formal attributes of the proposal (Cross, 1990). Schön's theory of reflection in action (1983), discusses the fact that the architectural knowledge derives from very differing areas of scientific and aesthetic thinking remains open to a large degree (Schön, 1983). Oxman (1990) claimed that, the reasoning processes which occur in the recall and restructuring of knowledge are among foundations of design; they may also provide a basis for the explanation of creativity.

There are also arguments whether creativity is latent potentiality or an improvable characteristic. The studies about the dialectic between knowledge and creativity have contradictory findings. There are two different approaches to the effects of limits on creativity. According to the first approach, creativity increases parallel to the increase of knowledge and also creative thinking only can emerge from the synthesis of different information networks and knowledge connections. Creativity could be advanced through training (Parnes & Noller, 1972; Torrance, 1990). But according to the second approach, any increase of knowledge produces decrease creativity (Dunin-Woyseth, 1996). Teymur (1993) suggested that, in architectural education first year can be both creative in an unfettered way and responsibly mindful of the world, whilst the upper years can be both professionally rigorous and intellectually adventurous. Despite the contradictory arguments about effects of knowledge on creative thinking, there has been little empirical and experimental research in the architectural design education literature.

Future studies should explore both direct and indirect paths linking creative thinking to architectural education which is our focus here. So that the main aim of this research was to provide theoretical suggestions with an experimental method.

CASE STUDY

According to Aslan (1999) who adapted the original form TTCT into Turkish and developed language equivalency, reliability and validity researches, TTCT has been applied to different fields of educational disciplines such as music, painting, medicine, linguistic, agriculture, urban design, social sciences in Turkey. However, creative thinking the most crucial part of design studio process, TTCT has never been used as a psychometric measurement in architectural education. To test the effectiveness of professional knowledge on the improvement of general creative thinking abilities, TTCT has been applied to first and last stage of architectural design education process at Yıldız Technical University. The most important feature of this research is that, this is the first application in architectural education.

Purpose and Objectives

The main purpose of this study was to explore the relationship between different sample groups of architectural design students' level of creative thinking abilities. In order to achieve this aim, the answers to these questions tried to be found.

- Is there any significant difference in general creative thinking between two sample groups (first year, last year)?

- Is there any effect of architectural design education on the improvement of general creative thinking abilities?

Instruments

The main instrument of this research is Torrance Tests of Creative Thinking. Besides TTCT, in order to collect demographic data about individual differences of students (sex, educational background, educational levels of parents, etc.) a questionnaire was devised for this research.

TTCT was developed by Dr. E. Paul Torrance and his associates in 1966. There are two forms of TTCT: Verbal and Figural. They have been re-normed four times in 1974, 1984, 1990, and 1998. Scholastic Testing Service holds the copyright for the TTCT and has provided a 1998 norms manual for the test. TTCT is an extensive battery of tests devised to measure creative abilities, with a particular emphasis on divergent thinking. It is based on the divergent thinking creativity theory of Guilford (1986). This is a paper - and - pencil test which can be applied to all people of all ages and abilities. TTCT adapted to Turkish by Yontar (1985) and statistical studies concerning the language equivalency, reliability and validity of adapting test into Turkish has been developed by Aslan (1999).

Torrance (1974) has suggested the following uses for the test:

- to understand the human mind and its functioning and development
- to discover effective bases for individualizing instruction
- to provide clues for remedial and psychotherapeutic programs
- to evaluate the effects of educational programs, curriculum, teaching procedures.
- to be aware of latent potentialities.

The TTCT has been translated into 35 languages (Miller, 2002). It is the most widely used test of creativity, and had the most references of all creativity tests. The standard administration and scoring procedures, as well as the development and evaluation, have made the TTCT especially useful for identifying gifted and talented students. Therefore, the TTCT appears to be a good measure not only for identifying and educating the gifted, but also for discovering and encouraging everyday life creativity in the general population. Intra-rater reliability coefficients are reported by the developer above the .90 level with content and construct validity established (Torrance, 1990). Compared to the subjectivity of many IQ tests and other psychological tests, the scores of the TTCT can be trusted. According to Treffinger (1985) TTCT is the most researched and analyzed one among any other instruments that can be used for measuring creative thinking.

TTCT tests creativity using 5 norm - referenced measures: (Torrance, 1990)

- Fluency: by the number of interpretable, meaningful, and relevant responses,
- Originality: by responses which are unexpected, unusual or statistically rare,
- Abstractness of titles: by the level of abstraction given to the titles of the pictures,
- Elaboration: by the addition of pertinent details,
- Resistance to premature closure: by the ability to keep open in processing information and the consideration of the variety of information given in responses

There are also, 13 criterion-referenced measures on creative strengths (Table 5).

Participants

A total of 148 undergraduates at Architectural Department of Yıldız Technical University took part in this study. The research was carried out on two sample groups; from different levels of education (51 Year One and 97 Year Four undergraduates). Participants were selected randomly from architectural design courses. There were no refusals, although 2 students forget to write their name on the booklet. The first sample group (First Year) consisted of 35 females and 16 males with a mean age of 18,9 years. The second sample group (Last Year) consisted of 53 females and 44 males with a mean age of 23, 5 years.

Procedure

The TTCT figural test was set out different studio courses and programs. In this research only figural test which composed of three activities was applied.

- *Activity 1*. that composes a drawing so that the given curved shape forms a portion of the entire drawing (Picture Construction);
- *Activity 2* that completes a drawing with given imperfect figures (Picture Completion);
- *Activity 3* that makes as many drawings as possible with a set of two lines (Lines).

They require 10 minutes to complete each activity. In Activity 1, *Picture Construction* task, participants are presented with a colored curved shape, and asked to think of a picture or an object, which they can draw with the shape as a part. They encouraged to think of as original a picture or object as possible and keep adding new ideas to their first idea to make it tell as interesting and as exciting a

Table 1. Demographic Data (first year students)

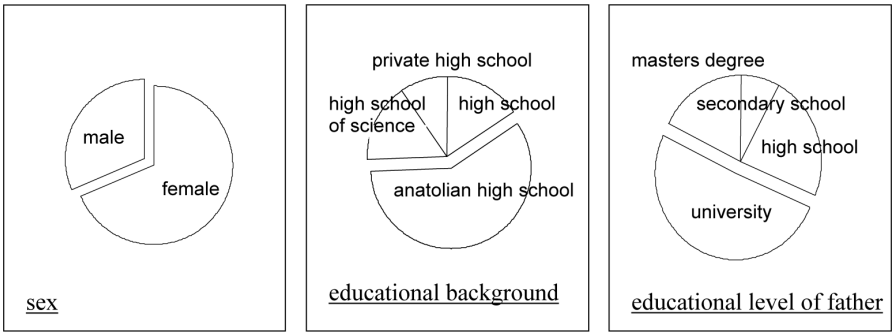
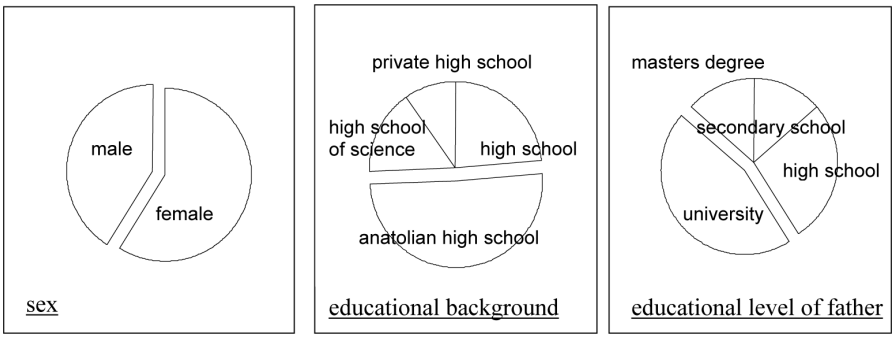


Table 2. Demographic Data (last year students)



story as they can. When they have completed their picture or object they have to think up a name or title for it. Activity 2 requires the subject to use ten incomplete figures to make and to name an object or picture. They encouraged creating some pictures or objects that no one else could think of. The last activity is composed of three pages of lines which the subject is to use as a part of his or her picture. The pairs of straight lines should be the main part of whatever they make.

All participants were informed that the questionnaire was part of a research. Students were given detailed instructions on how to complete the booklet. Testing in large groups of combined classes is avoided. The maximum class size was 35. The psychological climate, both preceding and during the use of the tests, tried to be as comfortable and stimulating as possible. Both norm and criterion referenced measures were estimated by expert raters. The data were analyzed using the version of SPSS.

RESULTS

Although the main aim of this research is to compare the general creative thinking abilities of two different sample groups (First Year – Last Year), the effects of

some other variables (sex, educational background, educational levels of parents etc.) on creativity were explored.

The analysis of variance (ANOVA) tests were conducted in order to find out if the educational background (kind of high school graduated from) has any effect on the total marks of creative thinking (Table 3). The ANOVA for each sample group (first year – last year) did not indicate any statistically significant difference.

Table 3. Anova Test Scores According to Kind of High School Graduated From.

	(I) kind of high school	(J) kind of high school	Diff. (I-J)	Std. Error	Sig.	95% Confid. Interval	
						low.	upp.
Scheffe	high school	anatolian high s.	5.56	2.72	**0.26**	-2.32	13.44
		high s. of science	2.83	3.41	**0.88**	-7.07	12.72
		private high s.	1.33	3.89	**0.99**	-9.96	12.61
	anatolian high school	high school	-5.56	2.72	**0.26**	-13.44	2.32
		high s. of science	-2.73	2.72	**0.80**	-10.61	5.15
		private high s.	-4.23	3.30	**0.65**	-13.80	5.33
	high school of science	high school	-2.83	3.41	**0.88**	-12.72	7.07
		anatolian high s.	2.73	2.72	**0.80**	-5.15	10.61
		private high s.	-1.50	3.89	**0.99**	-12.79	9.79
	private high school	high school	-1.33	3.89	**0.99**	-12.61	9.96
		anatolian high s.	4.23	3.30	**0.65**	-5.33	13.80
		high s. of science	1.50	3.89	**0.99**	-9.79	12.79
Dunnett C	high school	anatolian high s.	5.56	3.38		-5.45	16.56
		high s. of science	2.83	4.48		-12.01	17.66
		private high s.	1.33	3.78		-11.97	14.62
	anatolian high school	high school	-5.56	3.38		-16.56	5.45
		high s. of science	-2.73	3.30		-13.46	7.99
		private high s.	-4.23	2.26		-12.74	4.27
	high school of science	high school	-2.83	4.48		-17.66	12.01
		anatolian high s.	2.73	3.30		-7.99	13.46
		private high s.	-1.50	3.70		-14.57	11.57
	private high school	high school	-1.33	3.78		-14.62	11.97
		anatolian high s.	4.23	2.26		-4,27	12,74
		high s. of science	1.50	3.70		-11,57	14,57

A similar strategy was used to analyze the relation between educational background of parents and creativity of students. The One-way ANOVA was carried out to test the effects of educational levels of parents (primary school, secondary school, high school, university, masters degree) on creative thinking ability. ANOVA results showed that there were not statistically significant mean differences between different groups (Table 4).

Although it was expected that the educational background of students and their parents would be a significant criteria on creativity, the results did not verify this assumption. The main reason of this result can be explained with the similarities from the educational perspective of the participants. In Turkey, after high school education students have a general preliminary examination that measures general academic ability. The examination scores of students who were accepted to the same faculty are very similar to each other. Although the central examination measures only linguistic - logical - mathematical forms of intelligence and natural science knowledge, it can be evaluated as an elimination system. Special abilities such as visual – spatial intelligence and creative thinking were not considered in these measuring standards. Despite the fact that, because of the similarity in *g factor* (the general intelligence factor) of participants, educational background of students and their parents would not be the most important criteria on creativity.

Table 4. ANOVA Test Scores According to The Educational Level of Father

	(I) Educational level of father	(J) Educational level of father	Mean Diff. (I-J)	Std. Error	Sig.	95% Confid. Interval	
						low	upp.
Scheffe	secondary school	high school	1.92	4.09	**0.97**	-10.12	13.96
		university	0.19	3.31	**1.00**	-9.56	9.95
		masters degree	-1.03	3.93	**1.00**	-12.62	10.55
	high school	secondary sch.	-1.92	4.09	**0.97**	-13.96	10.12
		university	-1.73	3.02	**0.95**	-10.62	7.16
		masters degree	-2.95	3.69	**0.89**	-13.82	7.91
	university	secondary sch.	-0.19	3.31	**1.00**	-9.95	9.56
		high school	1.73	3.02	**0.95**	-7.16	10.62
		masters degree	-1.22	2.81	**0.98**	-9.49	7.04
	masters degree	secondary sch.	1.03	3.93	**1.00**	-10.55	12.62
		high school	2.95	3.69	**0.89**	-7.91	13.82
		university	1.22	2.81	**0.98**	-7.04	9.49
Dunnett C	secondary school	high school	1.92	5.11		-22.37	26.21
		university	0.19	5.04		-23.43	23.81
		masters degree	-1.03	5.15		-25.26	23.20
	high school	secondary sch.	-1.92	5.11		-26.21	22.37
		university	-1.73	2.04		-8.92	5.46
		masters degree	-2.95	2.30		-11.83	5.92
	university	secondary sch.	-0.19	5.04		-23.81	23.43
		high school	1.73	2,04		-5,46	8,92
		masters degree	-1.22	2,15		-8,43	5,98
	masters degree	secondary sch.	1.03	5,15		-23,20	25,26
		high school	2.95	2,30		-5,92	11,83
		university	1.22	2,15		-5,98	8,43

A t–test was conducted in order to test the effects of sex on creativity. Although there was not a significant difference among sexes for each sample group, according to the test results, totally the creativity of male students were higher than female students.

Table 5. T-Test Scores TTCT According To Education Level (First Year, Last Year)

	Levene's for Equality Variances			**T-Test for Equality of Means**						
		F	Sig	t	df	**Sig. 2-tailed)**	Mean Diff.	Std. Err. Diff.	95% Confid. Interval of Diff.	
									low.	up.
TTCT Total (*)	e.v.a.	13.1	.00	- 1.8	146.0	**.045**	- 2.92	1.56	- 6.00	0.18
	e.v.n.a			- 2.0	135.3	**.039**	- 2.92	1.40	- 5.60	- 0.14
Fluency (**)	e.v.a.	7.6	.00	- 3.3	146.0	**.001**	- 5.90	1.74	- 9.30	- 2.40
	e.v.n.a			- 3.6	124.2	**.000**	- 5.90	1.62	- 9.10	- 2.60
Originality (*)	e.v.a.	16.0	.00	- 2.2	146.0	**.025**	- 3.97	1.75	- 7.40	- 0.49
	e.v.n.a			- 2.5	133.5	**.013**	- 3.97	1.58	- 7.10	- 0.83
Abstractness of Titles	e.v.a.	3.4	.06	.44	146.0	.657	0.41	.92	- 1.40	2.20
	e.v.n.a			.47	119.5	.638	0.41	.87	- 1.30	2.10
Elaboration	e.v.a.	6.5	.01	- 1.5	146.0	.112	- 0.82	.51	- 1.80	.19
	e.v.n.a			- 1.6	119.7	.092	- 0.82	.48	- 1.70	.13
Resistance to Closure (**)	e.v.a.	17.1	.00	- 3.5	146.0	**.000**	- 1.50	.42	- 2.30	- 0.67
	e.v.n.a			- 4.1	144.0	**.000**	- 1.50	.36	- 2.20	- 0.78
Emotional Expresiveness	e.v.a.	1.1	.28	.20	146.0	.842	0.03	.15	- 0.27	.33
	e.v.n.a			.20	105.2	.842	0.03	.15	- 0.27	.33
Storytelling Articulateness	e.v.a.	1.7	.19	- 0.33	146.0	.741	- 0.04	.14	- 0.34	.24
	e.v.n.a			- 0.33	108.2	.735	- 0.04	.14	- 0.33	.24
Movement or Action	e.v.a.	3.7	.05	- 0.94	146.0	.345	- 0.13	.14	- 0.42	.14
	e.v.n.a			- 0.98	114.0	.325	- 0.13	.13	- 0.41	.13
Expressivenes s of Titles	e.v.a.	7.6	.00	1.15	146.0	.252	0.18	.15	- 0.12	.49
	e.v.n.a			1.19	113.6	.234	0.18	.15	- 0.11	.47
Synthesis of Incomplete f.	e.v.a.	1.1	.29	- 0.51	146.0	.601	- 0.03	.06	- 0.16	.09
	e.v.n.a			- 0.56	127.8	.574	- 0.03	.06	- 0.15	.08
Synthesis of Lines or Circles	e.v.a.	3.8	.05	- 0.93	146.0	.353	- 0.08	.09	- 0.27	.10
	e.v.n.a			- 1.0	129.5	.309	- 0.08	.08	- 0.26	.08
Unusual Visualization	e.v.a.	1.1	.27	.53	146.0	.591	0.07	.13	- 0.19	.34
	e.v.n.a			.52	94.3	.601	0.07	.14	- 0.20	.35
Internal Visualization	e.v.a.	4.4	.03	- 0.35	146.0	.721	- 0.04	.13	- 0.32	.22
	e.v.n.a			- 0.37	113.3	.710	- 0.04	.13	- 0.31	.21
Extending or Breaking b.	e.v.a.	7.6	.00	- 1.1	146.0	.259	- 0.15	.13	- 0.41	.11
	e.v.n.a			- 1.2	123.6	.225	- 0.15	.12	- 0.39	.09
Humor (*)	e.v.a.	24.4	.00	- 2.3	146.0	**.020**	- 0.27	.11	- 0.51	- 0.04
	e.v.n.a			- 2.6	140.2	**.008**	- 0.27	.10	- 0.48	- 0.07
Richness of Imagery	e.v.a.	5.7	.01	- 1.0	146.0	.305	- 0.12	.12	- 0.37	.11
	e.v.n.a			- 1.1	124.3	.270	- 0.12	.11	- 0.35	.10
Colorfulness of Imagery	e.v.a.	1.4	.23	.64	146.0	.522	0.035	.05	- 0.07	.14
	e.v.n.a			.63	98.0	.528	0.03	.05	- 0.07	.14
Fantasy	e.v.a.	2.2	.13	.76	146.0	.445	0.03	.04	- 0.05	.13
	e.v.n.a			.69	78.8	.489	0.03	.05	- 0.06	.14

(*) The mean difference is significant at the 0.05 level (sig 2-tailed, p<.05)
(**) The mean difference is significant at the 0.01 level (sig 2-tailed, p<.01)
e.v.a. equal variances is assumed
e.v.n.a. equal variances is not assumed

In order to compare the general creative thinking abilities of two different sample groups (First Year – Last Year) a t–test was carried out. According to the scores of the t–test, it was obvious that in creativity measures there were significant differences between two sample groups (Table 5).

When we compare the TTCT Figural total scores, norm and criterion referenced measures of the first year and the last year students, it can be seen from the table 6 that, at the end of architectural education last year students scored higher on the *fluency*, *originality*, *resistance to premature closure* and *humor* dimensions of TTCT. Figural Creativity (total) score which includes all norm and criterion referenced measures of last year students is also significantly higher. The *mean difference* is significant at the 0.05 level (sig 2-tailed, p<.05) for *Figural Creativity (total) score*, *originality*, and *humor*. Also the mean difference is significant at the 0.01 level (sig 2-tailed, p<.01) for fluency and *resistance to premature closure*. T-test revealed that last year students were significantly more creative than first year students.

This findings do not support the hypothesis suggested that when the professional and technical knowledge increases over the years, the creativity and inventiveness tend to decrease. However there is not an aptitude test to assess potential creativity of applicants for entrance to an architectural program and there is not *Creatology* course in the architectural education curriculum, this finding suggest that general creative thinking ability improves in design education. The main reason of this result can be explained with the nature of the design issue and learning and teaching methods employed in design studio.

In order to test the effectiveness of design education on the improvement of creativity, TTCT should be tested again on the first sample group (first year), after three years. If there will be a significant difference between TTCT measures of the same sample group in different years, it become evident that *architectural design education has a significant effective role on the improvement of general creative thinking abilities*. In order to reach more reliable psychometric evidence the sample size of groups from each level of education should have increased. Moreover, research process continues at Yıldız Technical University Faculty of Architecture.

CONCLUSION

Architectural education must be designed deliberately to enhance and to develop students' creative thinking and abilities. When the main result of this case study

was considered, architectural design education accomplished with this important objective. The results of the t-test showed that last year students were significantly more creative than first year students. Although this result suggests hopeful assumptions, it is not enough to say; *creativity will be advanced through architectural training*. More research is also required about this subject. The experimental base of this assumption should be developed further, so that more rigorous conclusions and conclusions which can be generalized can be drawn from this.

The common finding of international researches indicated that, with the various exercises of creatology courses such as fluent thinking, flexible thinking and divergent thinking, TTCT total marks of students increased evidently. Although creativity takes place in the most important objectives of design studio, there is not any course known as *Creative Studies or Creatology* in the curriculum.

This matter gains more importance, when the objectives of architectural education are considered. In architectural design studio, students should be educated not only to solve ill defined design problems, but also real world problems. After architectural education program they should adopt their own creative expression improving with design skills and knowledge to ill structured - ill defined - wicked real world problems. Although one of the sentimental aims of architectural education must depend on *developing creative personality*, the traditional academic organization of the university curriculum is primarily focused on professional knowledge and skills.

When all facts about educational background of architectural design students are considered, it is obvious that curriculum must be discussed twice from the perspective of *creative thinking*. Considering the characteristics of architectural design students who were short of innovative training in their former study at school and real situation of our traditional frontal teaching model, it is necessary to discuss the issue about the improvement and measurement of the creative thinking in architectural education.

REFERENCES

ADAMS, J.L. (1998), *Conceptual Blockbusting: A Guide to Better Ideas*, Addison-Wesley Publishing Company Inc., (MA), USA.

ASLAN, E. (1999), Turkish Version of Torrance Test of Creative Thinking in *Proceedings of International Conference on Test Adaptation,* Goerge Town University, Washington D.C.

BOYER, E.L. and MITGANG, L.D. (1996), Building Community: A New Future for Architectural Education and Practice, A Special Report, Carnegia Foundation for The Advancement of Teaching, Princeton, NJ.

BROADBENT, G. (1975), *Design in Architecture*, John Wiley & Sons, New York.

CHAN, C.S. (1990), Cognitive Processes in Architectural Design Problem Solving, *Design Studies*, (vol. 11, no. 2) pp. 60-79.

CROSS, N. (1990), The Nature and Nurture of Design Ability, *Design Studies,* (vol. 11, no. 3) pp. 127-140.

DUNIN-WOYSETH, H. (1996), Doctorates in Design and Architecture in *Proceedings of EAAE Conference,* (*v*ol. 1) pp 65-76.

GUILFORD, J.P. (1986), *Creative Talent: Their Nature, Uses and Development*, NY: Bearly Limited, Buffalo.

GOLDSCHMIDT, G. and WEIL, M. (1998), Contents and Structure in Design Reasoning, *Design Issues,* (vol. 14, no. 3) pp. 85-101.

LAWSON, B. (1997), *How Designers Think*, (3rd edt.), Architectural Press, Oxford.

MILLER, G.W. (2002), *The Torrance Kids at Mid-Life,* CT: Ablex, Westport.

NERVI, L. and RICKEN, H. (1990), Der Archkitekt-Ein Historisches Berufsbild, *Deutsche Verlag Anstalt*, pp.163.

OXMAN, R. (1990), Prior Knowledge in Design: A Dynamic Knowledge-Based Model of Design and Creativity, *Design Studies*, (vol. 11, no. 1) pp 17-27.

PARNES, S.J. and NOLLER, R.B. (1972), Applied Creativity: The Creative Studies Project, *Journal of Creative Behavior*, (vol. 6, no. 3) pp. 164-186.

SCHÖN, D.A. (1983), *The Reflective Practitioner: How Professionals Think in Action*, Basic Book Inc., USA.

TEYMUR, N. (1993), Initiation Myths and Curricular Fantasies, in *Proceedings of ACSA/EAAE, Beginnings in Architectural Education*, ACSA, New York, pp 89-91.

TORRANCE, E.P. (1974), *Torrance Tests of Creative Thinking, Verbal and Figural: Directions, Manual and Scoring Guide,* New York: Personal Press, New York

TORRANCE, E.P. (1990), The Torrance Tests of Creative Thinking: Norms-Technical Manual, Scholastic Testing Service Inc, Bensenville, IL.

TREFFINGER, D.J. (1985), *Review of The Torrance Tests of Creative Thinking, The Ninth Mental Measurements Yearbook*, Lincoln: Buros Institute of Mental Measurements, University of Nebraska, USA.

WILLEM, R.A. (1990), Design and Science, *Design Studies*, (vol. 11, no. 1) pp 43-47.

YONTAR, A.A. (1985), *The Effects of Method and Sex on Science Achievement Logical Thinking Ability and Creative Thinking Ability of 5th Grade Students*, METU (unpublished masters thesis), Ankara.