EFFECTS OF ACTIVE STRATEGIC TEACHING MODEL (ASTM) IN CREATIVE AND CRITICAL THINKING SKILLS OF ARCHITECTURE STUDENTS

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Keywords
Architectural design education; active strategic teaching model; critical and creative thinking skills; architectural design process.

Abstract
Improving creative and critical thinking is one of the most important objectives in architectural education. The present research has been performed to investigate the effects of active strategic teaching model (ASTM), on creative and critical thinking skills of architecture students. This quasi-experimental study is of a causal-comparative type and was done as two-group experimental research (control and intervention) using pre-test, post-test method during 2014-2016. The statistical society of the research consists of students of Architecture Design Studio 4 at Tabriz Islamic Art University. The students of control group were carried out with conventional method while the intervention group received active strategic model. The creative and critical thinking skills were compared in both groups in specific dimensions based on reviewing the design process. The statistical analysis was conducted by SPSS software and descriptive statistics, independent t-test, chi-square and ANOVA were used. However, interpretation of the results weren’t causal. In this review, the majority of students could obtain proper results dependent on the amount of their efforts which indicate the relative success of both methods. But, comparing the mean differences of the results in two groups shows a significant difference in enrichment of critical and creative thinking skills of the intervention group in comparison with the control group. In fact, using ASTM led to develop the critical and creative thinking skills as one of the main missions of architectural education and finally led to more and also sustainable achievements in creative procedure of architectural design.

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INTRODUCTION

Thinking correctly in every domain of knowledge is a necessity for an architect. Nowadays, architects face complex challenges in the field of architectural design and its procedure, which demand critical and creative thinking in the course of problem-solving. Information technology advances constantly nowadays and this poses a challenge for architects and planners (Salama & Courtney, 2013: 53) especially in design thinking approach. Critical and creative thinking increases the power of correct decision-making of students in recognition of design demands and selection of the most ideal solutions and methods for the design process. These types of thinking are considered as the important dimensions of professional operation in architecture and its education, particularly in the field of design. In fact, the critical and creative thinking is the necessary part of design pedagogy, design process and professional adequacy of architects. The critical thinking is a cognitive procedure in which decision-making is conducted by reviewing reasons and analyzing of available data. In other words, critical thinking is a self-monitoring (Ghanizadeh, 2017) and a purposeful judgment procedure which helps students to have a proper selection to solve the problems. Creative thinking is an ability to create and innovate (Poon, 2017). Creativity is a way of operating (Popova, 2015). Creativity takes multiple perspectives on a problem and needs the generation of ideas that are then evaluated to switch between different thoughts (Gabora & Ranjan, 2012; Howard-Jones, 2000; Kaufman, 2011). In fact critical thinking is the process that the architects should use to reflect on, assess and judge the assumption underlying their own and others ideas and efforts and creative thinking is the process that involves the interaction of both associative and analytic thoughts (Beaty, Silvia, Nusbau, Jauk and Benedek, 2014), that are unique, useful and noteworthy. The key skills of critical and creative thinking which have been compared in this research during the architectural design process are identified in the research methodology, Table 1.

Architectural design process includes a large number of decisions and needs a creative endeavor with mode shifting to generate and evaluate ideas (Cross, 2011; Dorst & Cross, 2001). This mode shifting is so important in the design process (Lawson, 1997) and this process requires the skill of "design thinking" which should be critical and creative. Therefore, the teaching method and the way of guidance during the design process are really important for improving thinking skills. The common architectural teaching methods in universities provide individuals with plenty of theoretical information but don’t exactly teach them a proper way of dealing with the practice of architecture. In reality, the traditional teaching methods in universities transfer composition of data and concepts to the students, but don’t teach them how to analyze, prioritize, organize and integrate the emerging knowledge which is the necessity of design thinking that leads to effective and meaningful learning. Therefore, for developing the proper thinking skills, the role of schools as the source of information and professors as the transmitter of data should be updated. Today, design studios are where students learn to “think architecturally”. In the studio, students have the main responsibility for figuring their way through the design problem, and the mentor’s role is mainly to ensure that they do not drift too far off-course (Al Khalifa, 2017:26). The students should try to improve their thinking and reasoning skills in order to be able to process and apply the information rather than just memorizing them.

Active strategic teaching model (ASTM) is an educational approach which can be used during the design stages in providing content to implementation and evaluation. The proposed model displays the relationship between these stages in a consistent and hierarchical way that facilitates meaningful proceeding. The framework of ASTM was developed according to the experiences obtained from consecutive years of teaching in
architectural design studios. The main idea is that the design process can be completed in a purposeful way with the establishment of meaningful relationships between different stages. Objectivity and flexibility, are essential for solving design problems, and changes in this process, through meaningful way, seems to be beneficial and required. In this study, the effect of ASTM in the improvement of creative and critical thinking skills among the mentioned group are examined and evaluated.

RESEARCH BACKGROUND

Architectural design is the core of the architecture program in most architectural schools in the world. Nowadays Architectural studios and engineering consultancies are reinventing themselves to adapt to social, technological and productive needs (Masdèu & Fuses, 2017:6). Learning is an active and internal process in which students actively use their knowledge in generating new ideas. The learners select and transform information, construct hypotheses, and make decisions in order to find a solution for a problem (Salama, 2015). In this way, the teacher should try and encourage students to discover principles by themselves. The teacher and students should engage in an active dialogue.

Bruner has claimed that we should not provide data to a learner but face him with a problem or a situation in order to discover the relations between different aspects of problems and solutions (Bruner, 1966). The educational program should also be developed in an interactive way so that the learners are provided with positive approach and motivation.

In the research conducted by Cakir and Yurtsver at Karabuk University in 2013, the projects designed by students in architectural design studio 5 were reviewed in order to evaluate the critical thinking skills in the course of architectural education. The results of this research showed that students could have a good critical view about known situations and could review and analyze them with more precision. The research emphasized on the necessity of the revision of current teaching strategies and utilization of new strategies in order to improve the critical thinking skills during the design process to solve the problem between the fields of practice and education creatively. Due to the results observation and experience of various procedures of problem-solving process during the architectural education is so important. In this process, all of the students evaluate their situations, problems and the details and elements that they use in a multi suggestion condition, so this develops the way of critical thinking about their own and the others’ projects. Students achieve awareness about the design problem and also they inquire and search with their own ideas (Cakir & Yurtsever, 2013).

In another study, an attempt has been made in order to examine the capacity of complex learning environments in design education. In this research, a comprehensive learning model has been proposed in which both attending traditional classes and web-based learning environments were considered. This model has made an optimal incorporation to create maximum learning and to allow for maximum flexibility in order to adjust to different environments. Observations and research that have been conducted in educational and professional environments in Iran, showed that architecture students usually don’t have right skills of critical and creative thinking and there are challenges in proposing a proper architectural design education. So students in architectural design studios suffer from ambiguity and confusion throughout the design process, especially in creative stages of the process from developing a design concept to final design stages (Kian Ersi, Talebi & Shabani 1390:45). Therefore, in design studios, critical and creative thinking skills of students should
be promoted to help them in solving problems and dealing with design challenges. This can be done by using a special program that provides an interactive relation between various features of design including analysis, criticism, review, evaluation, and conclusion (Whiley & et al., 2017). Since the implementation of this method can be time-consuming for architecture professors and its utilization could be considered challenging for novice teachers, it seems necessary to review its effects especially in innovation and critical thinking in order to propose a step-by-step and clear educational package that can be properly used by teachers. The present study has been designed and conducted with the aim of determining the effect of ASTM on critical and creative thinking skills of architecture students as an effective educational method for teaching architecture design studios.

METHODS

This study generally is conducted based on qualitative and quantitative methods and case study analysis. The first step is to describe the main concepts consciously and to determine their main infrastructures; through which, these concepts could be analyzed in the field of architecture. After the description of the framework of the concepts based on studies and experiences, the current research tries to examine the effect of teaching methods in architectural design studios during the design process. This goal is achieved by qualitative evaluation of projects, documents, and processes conducted by individuals and quantitative comparison of those in defined studios. So in this research, the results of the projects and also the success rate of students and the effectiveness of each method will be evaluated throughout a quasi-experimental study. This quasi-experimental study is done with two-design groups by evaluating them in a pre-test and post-test procedure. The statistical sample includes the students of architectural design studio 4, in Tabriz Islamic Art University, in two consecutive academic years (2014-2016), spring & fall semesters with the total of 78 students. Before starting the test, the students of the fall semester in the 2014-2015 academic year and spring semester in the 2015-2016 academic year were selected randomly as the control group and the students of the spring semester in the 2014-2015 academic year and fall semester in the 2015-2016 academic year as the intervention group. In both groups, the pre-test of critical and creative thinking skills and interest level about architecture was conducted. In fact, for pre-test, the previous projects of the students in past terms and the process that they have passed for problem-solving related to previous architecture design studios were reviewed and analyzed, again qualitatively and quantitatively.

In order to evaluate the creative and critical thinking skills in the post-test stage, the conducted procedure by the students in both control and intervention groups and the results of the design process were reviewed and analyzed in interim and final delivery stages. During this process, the skills of critical and creative thinking were considered as the main aim of the study. Five key skills of critical thinking and three key skills of creative have been compared between the results of both teaching methods in this research. These key skills which are presented in Table 1 have been selected from the references related to prominent professors who are primarily known for their research and writing on creative and critical thinking skills. The references that are mentioned in the table below, have introduced the key skills which are most closely align with the architecture design process and its necessities.

Creativity is a keyword in the explanation of the design process and education. Psychological researchers indicate that the creative process can be taught (Sawyer, 2012). For the success of an architectural design, skills, knowledge and insight of the designer in developing the
design concept, creativity and motivation are essential (Poon & Mazlina, 2017). Criticality is an opportunity for purposeful thinking and acting according to the criteria. So critical thinking establishes an appropriate relationship between different factors which affect problem conditions. In fact, critical thinking helps the process to have positive results due to the purposes. This aim of this study is measured through the fields of critical and creative thinking skills as expressed in table 1.

Table 1: Key skills of critical and creative thinking (Source: Facione, 1990; Amabile, 1996).

<table>
<thead>
<tr>
<th>Key skills of critical thinking (Facione, 1990)</th>
<th>Explanation</th>
<th>Analysis</th>
<th>Inference</th>
<th>Interpretation</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>- State results</td>
<td>- Identify arguments and claims</td>
<td>- Examine ideas</td>
<td>- Query evidence</td>
<td>- Categorize</td>
<td>- Assess credibility of claims</td>
</tr>
<tr>
<td>- Justify procedures</td>
<td>- Identify arguments</td>
<td>- Identify reasons</td>
<td>- Conjecture alternatives</td>
<td>- Decode significance</td>
<td>- Assess the quality of arguments (inductive or deductive)</td>
</tr>
<tr>
<td>- Present arguments</td>
<td>- State results</td>
<td>- Given what we know so far, what conclusions can we draw?</td>
<td>- Assess credibility of Claims</td>
<td>- -</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- What does this mean?</td>
<td></td>
<td>- -</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- What does this statement imply?</td>
<td></td>
<td>- -</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- If we accepted that assumption, how would things change?</td>
<td></td>
<td>- -</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- What additional information do we need to resolve this question?</td>
<td></td>
<td>- -</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- What are the consequences of doing things that way?</td>
<td></td>
<td>- -</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- What are some alternatives we haven’t yet explored?</td>
<td></td>
<td>- -</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Let’s consider each option and see where it takes us.</td>
<td></td>
<td>- -</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Are there any undesirable consequences that we can and should foresee?</td>
<td></td>
<td>- -</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- How credible is that claim?</td>
<td></td>
<td>- -</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Why do we think we can trust this person’s claims?</td>
<td></td>
<td>- -</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- How strong are those arguments?</td>
<td></td>
<td>- -</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Do we have our facts right?</td>
<td></td>
<td>- -</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- How confident can we be in our conclusion, given what we know now?</td>
<td></td>
<td>- -</td>
<td></td>
</tr>
</tbody>
</table>

The key skills of creative thinking (Facione, 1990) are:

1) skills related to domain or subject (knowledge and recognition towards facts, principles, theories, and ideas contained in given subject)

2) skills related to creativity (break a habit, understanding of complexity, thought broadness and communication)

and 3) skills related to motivation

The students and also the teacher should use critical thinking skills throughout all stages of the design process. In fact, during every stage (The program studies, sketches, design development, evaluation, and conclusion) the students should use the key skills of critical thinking. So the students and also the teacher should use critical thinking steps just completed in the situation described in figure 1. The students of the control group were carried out with the conventional method and
the intervention group received the ASTM, respectively, for 16 sessions during 4 semesters between 2014-2016. During the conventional method, the students proceed with their own design accordingly after they were provided the design brief. The teachers provide information and concepts within a time period at the initial sessions. Then each student goes through their own design process, after doing a general study on the design problem individually or collectively. In this way, only two-person conversations happen between the students and the teacher to discuss the design process and evaluate the results. Versus the students in the intervention group were informed about ASTM and the quality of its structure and planning in the first session. The explanations in relation to each stage were provided to students in their relevant sessions. The ASTM (presented in figure 1) were designed through reviewing the available resources and also experiences of design studios, where, the authors have attended.

![Diagram of the design process]

Figure 1: Active strategic model (Source: Authors, 2014).
Students carried out each stage according to the proposed model. After finishing each stage, students tried to have a conclusion and a discussion about the findings and to offer proper reviews and suggestions for improvement. In addition, the sectional results were evaluated by the professors and were returned to students for completion. The critical and creative thinking skills of both groups were reviewed in interim and final delivery stages. The statistics analysis was conducted by SPSS software. In addition to descriptive statistics (relative frequency and mean), following assurance of equality of distribution (Kolmogorov-Smirnov test), the independent t-test was utilized to compare mean score of critical and creative thinking and also the mean difference of the results between both groups. To compare the demographic features of both, Fisher's exact test were used to compare gender and marital status, ANOVA test was used to compare the previous knowledge level of architecture and interest in architecture, and also the independent t-test was conducted to compare the age and grade point average (GPA) of both groups in previous semester.

METHODOLOGY OF STUDENTS’ GUIDANCE IN ARCHITECTURAL DESIGN STUDIOS

Procedure

In the present research, the students of the architectural design studio 4 were selected to evaluate the two presented design methods in solving the design problem. The subject of all studios was the design of Passenger Terminal in Tabriz International Airport in order to have the same opportunity to test the critical and creative thinking skills. The students' activities and works were evaluated at any stage of the design process in relation to key skills (presented in table 1). In fact, during the semesters, it was tried to consider all projects in order to understand the problem-solving method used and to record the results of all stage. In this procedure, in the intervention group, tasks and sketches, group discussions, team evaluation and some active programs were used in any session. In some sessions, discussions and diverse sketches were set related to purposeful questions and data transaction. The main aim of these activities was to motivate students and face them with design challenges in order to promote their skills and knowledge and to train them in the ways of thinking. The teachers mostly played the role of advisor and consultant in this group. At the end of the discussions, in addition to summation about the subject by students, they submitted their own opinions in relation to performed sketches and also indicated their questions and recommendations about any item freely and actively.

In contrast, in control group, the students develop their design by the conventional method. In this case, after defining the design problem, each student develops his own design and proceeds different stages of the process in coordination with the professor. During this process, each student has individual corrections with the professor. The way of solving the design problem may differ from one student to another. In fact, each student does his or her design process in a teacher-centered manner.

Finally, the design project is delivered in two stages of interim and final. In this group the student's own effort, motivation, knowledge, ability, his own creativity and criticality in decision-making and the effort of the teacher to have positive conversations with the student during the corrections and some collective discussions and special activities that occur in the studio depending on need and discretion, help the students to promote their thinking skills during the architectural design process. In this research, the conducted works in both groups were divided and evaluated in any stage according to five key skills of critical thinking.
including explanation, analysis, inference, interpretation and evaluation and three key skills of creative thinking, including subject, creativity and motivation, as already discussed in this paper. The works of the students were reviewed and scored in different stages. As well these key skills were intended and targeted in the summary and conclusions in order to investigate and compare the success of each project in response to the design problem. The analysis conducted during the semesters has also been assessed with final results obtained at the end of the term. In fact, in this procedure, the mindset and the way of thinking, action, behaviour and attitude of students were considered and evaluated.

Data collection
The tools of data collection were student submission documents related to the interim and final delivery of the projects, because of their comprehensiveness. The evaluation of both stages was performed based on the related contents and objectives of each one. The score for each stage of the delivery was considered 10 that forms the total score of students in architectural design 4 studio. Indeed in the scoring of any stage, the different factors were involved. For example, during interim delivery, in addition to related documents to the design process, the study packages and case sketches and in final delivery, in addition to final documents of design, details related to structure, facade and interior design and presentation were considered in scoring, depending on their own ratings. The scoring of delivered documents was related to scoring of any part, quality of presentation, the extent of desirability, innovation, efficiency, suitability and beauty of provided response to the design problem. The teaching method didn’t have any influence on scoring strategy. In the following, the main examples of these projects are introduced.

Figure 2,3: Examples of the projects that have presented in control group in 2014-2015 Academic Year (Source: Authors, 2015).

Figure 4,5: Examples of the projects that have presented in intervention group in 2014-2015 Academic Year (Source: Authors, 2015).
Findings

The findings on personal characteristics showed that 54.2 percent of students were female and 91.8 percent of the total were single. The age average of intervention and control group were 21.22 and 21.42 respectively, as well as, the GPA average of past semester in intervention and control group were 17.22 and 17.13.

The students of both groups had moderate previous knowledge (46.71 percent) about critical and creative thinking skills and interest level about architecture was acceptable in both groups, (83.39 percent). The results of critical and creative thinking skills in both groups, before and after teaching by two methods, were provided in table 2 and 3. No significant differences were found in the variable of gender, marital status, previous knowledge level about thinking skills and interest level, age and previous semester GPA between both groups.

Table 2: Comparison of mean and standard deviation of critical and creative thinking skills and their key skills in ASTM and conventional groups before and after implementation (Source: Authors, 2016).

<table>
<thead>
<tr>
<th>stage</th>
<th>key skills</th>
<th>before ASTM</th>
<th>before conventional</th>
<th>independent t-test</th>
<th>after ASTM</th>
<th>after conventional</th>
<th>independent t-test</th>
<th>Significant level</th>
</tr>
</thead>
<tbody>
<tr>
<td>explanation</td>
<td>2.52±1.07</td>
<td>2.74±1.17</td>
<td>0.474</td>
<td>5.40±1.38</td>
<td>4.25±1.17</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>analysis</td>
<td>2.34±1.17</td>
<td>2.74±1.55</td>
<td>0.273</td>
<td>4.28±1.16</td>
<td>3.94±1.15</td>
<td>0.276</td>
<td></td>
<td></td>
</tr>
<tr>
<td>inference</td>
<td>2.34±1.42</td>
<td>1.83±1.56</td>
<td>0.184</td>
<td>6.94±1.73</td>
<td>4.55±1.44</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>interpretation</td>
<td>4.77±1.19</td>
<td>5.06±1.62</td>
<td>0.412</td>
<td>7.70±1.89</td>
<td>7.00±1.27</td>
<td>0.102</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3: Variance of mean scores of pre-test with post-test of creative and critical thinking skills and their key skills in ASTM and conventional group (Source: Authors, 2016).

<table>
<thead>
<tr>
<th>teaching method</th>
<th>ASTM</th>
<th>conventional</th>
<th>Significant level</th>
</tr>
</thead>
<tbody>
<tr>
<td>explanation</td>
<td>2.98±1.5</td>
<td>1.62±1.2</td>
<td>0.001</td>
</tr>
<tr>
<td>analysis</td>
<td>2.04±1.35</td>
<td>1.31±1.43</td>
<td>0.043</td>
</tr>
<tr>
<td>inference</td>
<td>4.71±1.51</td>
<td>2.83±1.46</td>
<td>0.006</td>
</tr>
<tr>
<td>interpretation</td>
<td>3.04±1.7</td>
<td>2.04±0.92</td>
<td>0.001</td>
</tr>
<tr>
<td>evaluation</td>
<td>4.46±1.45</td>
<td>2.83±1.13</td>
<td>0.001</td>
</tr>
<tr>
<td>subject</td>
<td>3.03±1.7</td>
<td>2.04±0.92</td>
<td>0.001</td>
</tr>
<tr>
<td>creativity</td>
<td>3.43±1.7</td>
<td>2.24±0.92</td>
<td>0.001</td>
</tr>
<tr>
<td>motivation</td>
<td>4.13±1.7</td>
<td>3.02±0.92</td>
<td>0.001</td>
</tr>
<tr>
<td>Total Score</td>
<td>8.31±2.17</td>
<td>4.55±1.78</td>
<td>0.001</td>
</tr>
</tbody>
</table>

DISCUSSION

The findings of this research indicate that ASTM had positive effects on critical and creative thinking skills. Based on the findings, the intervention group had significant positive changes in all key skills except "analysis" and "interpretation". Comparing the mean variance of scores changes in both groups with independent t-test shows the increased scores of intervention group than the control group in all key skills and in total scores. This increase just is not significant in "analysis". It is notable that, the comparison of critical and creative thinking skills, evaluates the key skills of creative and critical (as listed in table 1). It should be stated that students do not have to be proficient at every individual skill in order to be able to follow a proper decision-making process during the design stages. For example, a student might be successful in his/her design only by being proficient in some of the proposed skills. The study also shows that increases in the scores of students in intervention group during the design stages, reflects the positive effects of the active strategic model in comparison to conventional teaching method. Furthermore, according to the result, students educated by ASTM developed a better critical and creative capability in solving the design problem and dealing with challenges and have been able to interactively develop their design.

The reason for the promotion of critical and creative thinking skills with the use of ASTM is that, in this method, various stages of problem-solving in design process (defining problems, collecting information, brainstorming, analyzing, developing solutions, getting feedback and improving on design) are provided in a way that the relation between them, their importance and their effects could be recognized and examined easily and effectively. This promotes perception and also contributes learners to add new data to existing ones (existing cognitive structure). Consequently, this method provides a meaningful learning and promotes critical and creative thinking skills. Since with ASTM, a learner had an active role in his/her learning process, this led to the promotion of students in higher levels of creative and critical thinking. As Jon Dewey indicates, if a learner takes action to collect and prepare the findings actively,
the contents would be more meaningful for him (Dewey, 1982). But in the control group when students work alone, they don’t learn to collaborate with other students, and their skills suffer.

Results also indicate that clear organization of stages allows teacher and learners to exchange their own approaches regarding internal relations of each step of the process to each other and also to explore the missing relations and issues. This, in turn, will enable them to determine new teaching demands and to rearrange, update and evolve the model in order to promote critical and creative thinking skills. On the other hand, cross-connections between different levels of an active model that could reach higher levels of cognition is created due to creative thinking of learners (Novak & Alberto, 2006). Using a proper teaching method could help to provide training-based and comprehensive solutions, to prepare students for professional activities and to create a relationship between the theoretical and practical lessons (Black & et al,2000). Also, such method can reduce the anxiety of students and consequently provide the higher level of learning and increase their learning interest. In this way, the students go through different phases of thinking through a task and accomplishing it from start to finish.

The findings of the research also indicate that ASTM has positive effects during the design process, as the final delivery had significant promotion in comparison to early design stages and this is due to increased level of critical and creative thinking among students. Most projects of the intervention group are implemented as an evolutionary and gradual adaptation of existing structures. In these projects, what changes and evolves is the capabilities of those structures from a variety of dimensions; raw materials used, technical capabilities, form, and so on. In the projects of this group, the purpose and the meaning of the design process are quite obvious and they have successful back and forth procedure. Also, the degree of interaction between different design documents is remarkable. These items in relation to the control group is true about the fewer projects, but this relative success in relation to these few projects does not have a coherent approach. This research is looking for a model for the design process that is responsive, retrievable, flexible and informative. By using this model, most intervention group projects are designed with a thoughtful approach, while the level of imitation and eclecticism is high in control group projects.

It can be concluded that using ASTM and its features in the design studios could lead to more success in responding to design challenges and could develop mental, rational and design skills of students. So that, they could make accurate and suitable decisions during different levels of the design process.

CONCLUSION

The training of high-level thinking skills as one of the main mission of higher education necessitates the utilization of proper approaches which lead to the development of such thinking. With regard to the results of the present research, ASTM is an influential teaching method in promoting critical and creative thinking skills. Furthermore, the findings of this research show that ASTM can be considered as a top solution for the evaluation of creative and critical thinking skills since it reflects an image of thinking procedure to learners. Due to the limited research in this field, for a broader review of this approach in future studies, it is advisable that, active strategic models is to be prepared for each stage of the main model that has been used in this research. Also, this could be prepared by students themselves in small groups and based on their interest in carrying out that stage. The students in active strategic model group obtained higher scores in interim and in the final delivery stage than
those of the other group, which indicated the desired effects of this method in solving the design problem. Indeed, among the projects that had been presented by the conventional group, there were also few relatively good cases, but statistical tests showed significant variance between success levels of the intervention group.

There are a few points in this regard: First, the students in intervention group obtained better results in the final delivery stage which were much higher than those in the other group, and it was because of using ASTM process. The next point in relation to the students’ level of success is that in dealing with the design problems their personal ability, characteristics, interest, and knowledge, is so important. It is right that these are advantages in addition to the teaching methods, but what should not be ignored here is that the students' proficiency level, familiarization with concepts, tools, prospects and their motivation could be enhanced by utilizing the proper teaching methods and proper models for the architectural design process.

The achievements of the present research are the final projects of the students of architectural design studio 4. The projects that have been more successful in these studios are those that could utilize visualization and mental discipline in solving the problem simultaneously due to the ASTM theme and could evaluate and produce, at the same time, according to the ASTM process. In these studios, it was tried to contribute students in course of reaching better solutions but not necessarily new ones. In fact, solving the design problem, concluding and decision-making along with carefulness and deep thinking was one of the purposes of ASTM in architectural design studios. Through the development of thinking potentials, the students could think, understand and analyze accurately and make decisions based on values and criteria. The architects who taught consciously, using specific planning like ASTM, would have a critic and creative mind and also would be more successful in future.

The Iranian contemporary architecture requires public participation to strengthen the relationship between active strategic planning and architectural design process to develop a thoughtful design culture. The necessity of such actions is the education of all social levels continuously for a long term. It is clear that the universality of executive plans depends on comprehensive education methods and plays an important role in providing the objectives of sustainable development.

REFERENCES


