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Evaluation of Architectural Engineering Curriculum to Promote Vocational Education Based on Klein Model[1]

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ABSTRACT

The elimination of the needs of society by the higher education system requires constant change and modification of curriculum in line with developments. Whereas the predominant approach of third and fourth-generation universities is professionalism. And although the Bachelor of Architecture course is defined in the curriculum as a professional course; However, scientific and professional expectations in the undergraduate course have not been met; Therefore, the purpose of this study is to evaluate the architectural engineering curriculum; And it seeks to answer two questions: What challenges does the curriculum of architectural engineering face from the perspective of the Architecture teachers? And what steps are needed to review and modernize the architectural engineering curriculum in order to vocational education? The approach of the present study is quantitative. This research is applied research and in terms of data collection and control of variables is a descriptive survey. Library studies were used to formulate theoretical foundations and a questionnaire was used to collect data, which is based on Klein curriculum model and consists of 9 components and 71 items. Analysis of data based on a one-sample t-test in SPSS software showed that the curriculum in all nine components is challenged based on Klein's model; So that in 49 out of 71 items, that is 69% in the curriculum, there is a challenge. In the presented paradigm, all the elements of the curriculum are interconnected around the objectives. The low quality of each element casts doubt on the whole and the existence of the curriculum. Therefore, it is necessary to review the curriculum in a completely balanced, proportionate and coherent manner.

Keywords: *Architecture Education, Architectural Engineering Curriculum, Klein Model, Vocational Education*

1. Introduction

Rapid developments have led to considerable public attention to the fact that the higher education system is incapable of properly preparing individuals for work in the new environment. In these circumstances, meeting the needs of society by the higher education system requires constant change and modification of curricula in accordance with developments and in particular job needs. Studies show that the dominant approach of third and fourth generation universities is professionalism; What is clear, then, is the fundamental role of higher education

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in vocational training; In the future, helping to create jobs will be one of the basic principles of university work. There is a direct relationship between the training of specialized manpower required by the country in the field of architecture and the quality of the curriculum. And the curriculum, as the heart of any discipline, is the central pillar of the educational process and a means to achieve the goals of higher education, which are dynamic and in line with changing social and economic needs.

Although the bachelor of architecture course is defined in the curriculum as a professional course, however, scientific and professional expectations in the undergraduate course have not been met; Therefore, the present study aims to identify the challenges of the architectural engineering curriculum from the perspective of instructors in this field to improve and review in the direction of professional training; It seeks to answer two questions: What challenges does the curriculum of the field of architectural engineering face from the point of view of the professors of this field? And what steps are needed to review and modernize the architectural engineering curriculum to vocational education?

2. Literature Review

Richards (2013) defined the curriculum as a blueprint for an educational course and how to turn the content of a course into a general teaching-learning program, which makes it possible to achieve the desired learning outcomes [3]. In other researches, the curriculum as a key and important role in the educational system [6], [5], [4] and [2]; one of the important factors in improving the quality of higher education and the relevance of knowledge and skills of graduates to the latest scientific achievements and the needs of the labor market has been introduced [9], [8] and [7]. The curriculum Components are the mental tools of those who deal with curriculum planning [10]; The Components of the curriculum are numerous, and different perspectives have been put forward as to what the Components of the curriculum are. The types of patterns of curriculum Components from the perspective of experts in the field of curriculum planning are presented in Table (1). The number of curriculum Components in the 18 Patterns presented varies from 4 to 11 Components.

Table 1. Patterns of curriculum Components from the perspective of foreign and domestic experts in the field of curriculum planning (Source: Authors)

Patterns of curriculum Components	Researcher&Theorist
Four Components include: objectives, content, organizing experiences, and evaluation	(Tyler, 2013)
Seven Components included (expansion of Tyler's four Components): needs assessment, objects setting, content selection, content organization, selection of learning activities, organization of learning activities and evaluation	(Taba, 1962)
Seven Components include (Taba Pattern development): problem identification, problem identification, search for various solutions, selection of the best solution, approval of the solution, guidance and guidance of staff and evaluation of the effectiveness of the curriculum	(Wiles & Bondi , 1989)
Four Components include: purpose, content, learning activities and evaluation methods	(Zais, 1976)
Nine Components include: objectives, content, teaching-learning strategies, materials and resources, learners 'learning activities, evaluation methods, learners' grouping, time and space or environment	(Klein, 1986)
Five Components include: objectives, content, implementation and evaluation of the curriculum	(Lunenberg & Ornstein, 2004), (Ornstein & Hunkins, 2017)
Five Components include: a framework of premise and assumptions, general and specific objectives, content and nature of the subject, learning environments and evaluation methods	(Eash, 1991)
Five Components include: objectives, content, types of learning opportunities, content organization, response method and evaluation	(Eisner, 1994)
Seven Components include: objectives, content, sequence, learners, educational processes, educational resources, evaluation	(Stark & Lattuca, 1997)
Three Components include: objectives, content, and organizing learning content	(Walker, 2002)
10 Components include: logic + Klein's nine-element pattern	(Akker, 2003 & 2013)
Four Components include: objectives, content, implementation and evaluation	(Soltani, 2010)
11 Components include: logic, objectives, content, teacher competencies, teaching teaching	(Mazaheri, 2016)

methods, learning activities, time, family, learning environment, training package, evaluation	
Nine Components include: emphasis on needs assessment, objective selection, content selection, content organizing method, content presentation method, time setting, use of educational technology, and setting the evaluation method	(Zainuddin Meymand; Naderi; Shariatmadari; Seif Naraghi, 2010)
11 Components include: curriculum management, curriculum objectives, curriculum content, teaching-learning process, faculty, students, graduates, space, equipment and time, and evaluation of student learning	(Aliari, Maleki, Pazargadi, Abbaspour, 2012)
Nine Components include: emphasis on objectives, content, learning materials and resources, learning activities, implementation method, evaluation method, grouping, time, space and place	(Naderi, 2013)
10 Components include: logic + Klein's nine- Components pattern	(Fathi Vajargah, Khosravi Babadi and Hajatmand, 2015)
Four Components include: objectives, content, teaching methods and evaluation	(Hafezi, Abbasi, Niknam and grandson of Ibrahim, 2016)

All theorists such as Tyler, Ash, Zeiss, Bushemp, Eisner, Stark, and Lattuca have named the objective element as a fixed element in curriculum planning [6] and [1]. The purpose of the curriculum is to have the following benefits [11]:

- Orienting and giving meaning to curriculum activities;
- Allows curriculum planners to explore different ways to reach their destination.
- It is possible to compare the results.
- Allows you to review activities.

The curriculum is a learning roadmap and is a design and plan for organizing the Components to achieve the desired educational objectives [4]. A curriculum is implemented to make changes in learner behavior, these changes are called the objectives of the program [12]. Looking at the theories of education and research experts about the components of the curriculum (including: Fathi Vajargah and Shafiei, 2007; Khosravi et al., 2013; Mehr Mohammadi, 2002; Mazaheri, 2016; Yarmohammadian, 2015; Nili et al. , 2016) The most famous and complete understanding of the components of the curriculum in higher education is the model of the nine components of Francis Klein (1986) (among the 18 models examined in Table 1); He introduced the components of the curriculum in the form of nine components of "objectives", "teaching materials", "content", "learning activities", "teaching strategies", "evaluation", "grouping","time "and" place". Considering the important and key role of the objective component in the curriculum, the conceptual model of the present study was designed based on the Klein Pattern (number of Components) and adapted from the Acker model (spider web connection of Components) in nine Components of the curriculum (Figure 1); In this model, all the Components around the curriculum objectives are connected with the mission of orienting and giving meaning to other Components.

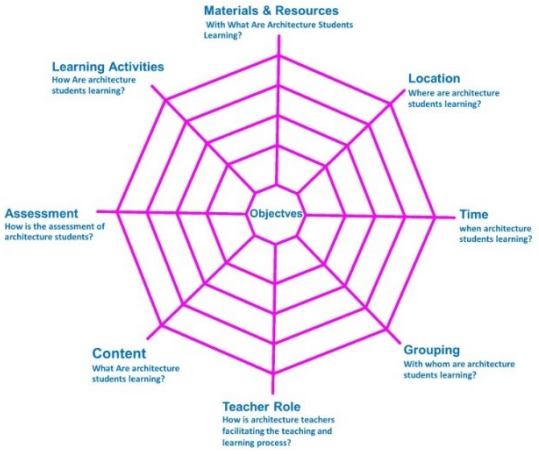

Fig 1. Conceptual model of research based on Klein (1986) Pattern in number and Akker model (2013) in how curriculum Components are related (Source: Authors)

In the proposed conceptual model, based on Acker's point of view, questions are asked to give meaning to the Components of the curriculum in the undergraduate course of architecture. The challenges of the architectural engineering curriculum have not yet been fully explored in all its Components in Iran; However, a review of previous research shows that each has examined the undergraduate curriculum from a specific point of view; As the results of the research of Jamiri et al. (2010) to review the curriculum in the field of architectural engineering to better adapt to the needs of the labor market in Iran show the status of architecture graduates according to the needs of the labor market, in terms of skills (skills and abilities needed in the world Real work) is undesirable and one of the main problems in the curriculum of architecture is the lack of coordination and overlap of theoretical and practical courses [2].

Razzaqi Asl (2011) in his research pointed to a comprehensive educational program for teaching architecture that has the advantages of both academic and professional learning environments [13]. Sedaghati and Hojjat (2015) examine the content of architecture education in Iran and measure the success of the undergraduate course in transferring this content, while emphasizing the difference between the content of architecture education and other academic disciplines is one of the reasons for failure in transferring educational content, especially technical and executive education. Lack of practical training along with theoretical training is considered that this lack of communication has led to superficial and non-practical training and moving away from professional skills [14].

Ebrahimian et al. (2016) by comparative comparison of new curricula with the old curriculum of architectural engineering showed that these revisions to organize the structure of architecture education to achieve three Objectives to meet the needs of the country, attention to Iranian-Islamic identity and coordination with the international education system It is not enough and there is a need to reconsider in line with the mentioned Objectives and respond as much as possible to the essential, real and competent needs of society [15].

Shahamat et al. (2015) After evaluating the hidden curriculum of architecture based on Islamic ethics, among the components of the hidden curriculum of this field, finally the two components of "cryptography of the teaching process" and "non-implementation of architectural plans" that make theoretical courses unrelated (With building technology) with practical courses (architectural design); Were introduced as issues in architecture education [16]. A review of the research backgrounds

showed that despite the fact that in the curricula and course topics, the undergraduate course in architecture is defined as professional courses that aim at transferring general knowledge and skills of the architectural profession and cultivating creative talent and achieving general efficiency in this field. However, in practice, the vocational training emphasized in the objectives of the curriculum has not been realized and this research emphasizes the need to modify and revise the architectural engineering curriculum based on the view of architecture professors as one of the pillars of the education system to provide a Pattern for vocational training.

3. Materials and Methods

The approach of the present study is quantitative. This research is in the category of applied research in terms of data collection and control of descriptive-survey variables. Library studies were used to formulate theoretical foundations and a questionnaire was used to collect data Based on the Klein Curriculum Components Pattern (1986), including 9 Components and 71 items related to the evaluation of the revised curriculum of the University of Tehran in the field of architectural engineering. The statistical population for the questionnaire is professors with experience and familiarity with the curriculum in the undergraduate degree of architecture who have at least one course of management experience in the department or have more than 10 years of professional and educational experience. For the questionnaire of 100 samples based on the minimum sample size required in survey research [17] Six random types of universities and higher education institutions were selected by simple random sampling. To analyze the data in order to test the research hypotheses and answer the research question, a one-sample t-test in SPSS software was used.

4.Results and Discussion

The present study includes two categories of descriptive and analytical findings. Initially, the descriptive features of the questionnaire showed that among the university teachers who answered the questionnaire, 69.2% were male and 30.8% were female so that the age status of the respondents showed 17.9% between 30 and 35 years, 28.2% between 36 and 40 38.5% between 41, 45 and 15.4% are over 46 years old. Out of

100 architecture teachers studied in this study, 46.2% (46 people) are tuition fees and 53.8% of the respondents are faculty members of the country's universities (29 instructors, 17 assistant professors, 4 associate professors, and 4 professors). Then, a one-group t-test was used to identify the challenges in the nine Components of the architectural engineering curriculum.

The results show that in the Component of curriculum objectives from the perspective of architecture professors, the experimental average values of items (2, 3, 4, and 9) are equal to (1.86, 1.30, 2.55, and 1.55), respectively (Table 2); Which are lower than the theoretical average (3); As a result, the H0 hypothesis that there is no difference between experimental and theoretical means is rejected and the H1 hypothesis based on the difference between experimental and theoretical means is accepted. According to the value level of significance (The Sig value in Table 2), which is less than 5%, with 95% confidence, we can say that the difference between the experimental and theoretical means is significant. Therefore, according to the professors, the architectural engineering curriculum faces challenges in the objectives, which include the unattainability of the educational objectives set during the implementation of the curriculum, the mismatch between the objectives of the curriculum and the predicted educational facilities, insufficient attention to interests and The needs of students in setting educational Objectives and not fully achieving the Objectives set in the field of architectural engineering (Challenges are highlighted in Table 2 in Gray).

In terms of curriculum content from the perspective of architecture professors (Table 3), it can be concluded that the experimental average values of items (10, 13, 15,16, 17, 18, and 19) are equal to (1.86, 2.85, 2.60, 2.38), respectively. 2, 1.96, 1.94 and 1.98); Which are lower than the theoretical average (3); And considering the value of the significance level (The Sig value in Table 3), which is less than 5%, it can be said with 95% confidence that the difference between the experimental and theoretical means is significant. Therefore, according to the professors of architecture engineering curriculum, it faces challenges in the content Component, which include low attention to knowledge and characteristics of the audience in content regulation, low ability of educational content to encourage students to active learning, the imbalance between theoretical and practical aspects in content The curriculum does not fit the number of courses with the volume of content, the lack of flexibility of the content in line with current knowledge, the small proportion of curriculum content with the duration of the 4-year undergraduate course and finally the content of the curriculum does not provide the necessary preparation for graduate professional activities. In terms of curriculum content from the perspective of architecture professors, it can be concluded that the experimental average values of items (10, 13, 15, 16, 17, 18, and 19) respectively are equal to (1.86, 2.85, 2.60, 2.38, 1.96, 1.94 and 1.98); Which are lower than the theoretical average (3); And considering the value of the significance level (The Sig value in Table 3), which is less than 5%, it can be said with 95% confidence that the difference between the experimental and theoretical means is significant. Therefore, according to the professors of architecture engineering curriculum, it faces challenges in the content Component, which include low attention to knowledge and characteristics of the audience in content regulation, low ability of educational content to encourage students to active learning, the imbalance between theoretical and practical aspects in content The curriculum does not fit the number of courses with the volume of content, the lack of flexibility of the content in line with current knowledge, the small proportion of curriculum content with the duration of the 4-year undergraduate course and finally the content of the curriculum does not provide the necessary preparation for graduate professional activities. Similarly, from the perspective of professors of architectural engineering curriculum, which has been revised by the University of Tehran (2013), it faces challenges in terms of learning activities, teaching strategies, learning materials and facilities, grouping, evaluation, place and time of learning. These challenges are shown in Figure 2 based on their severity.

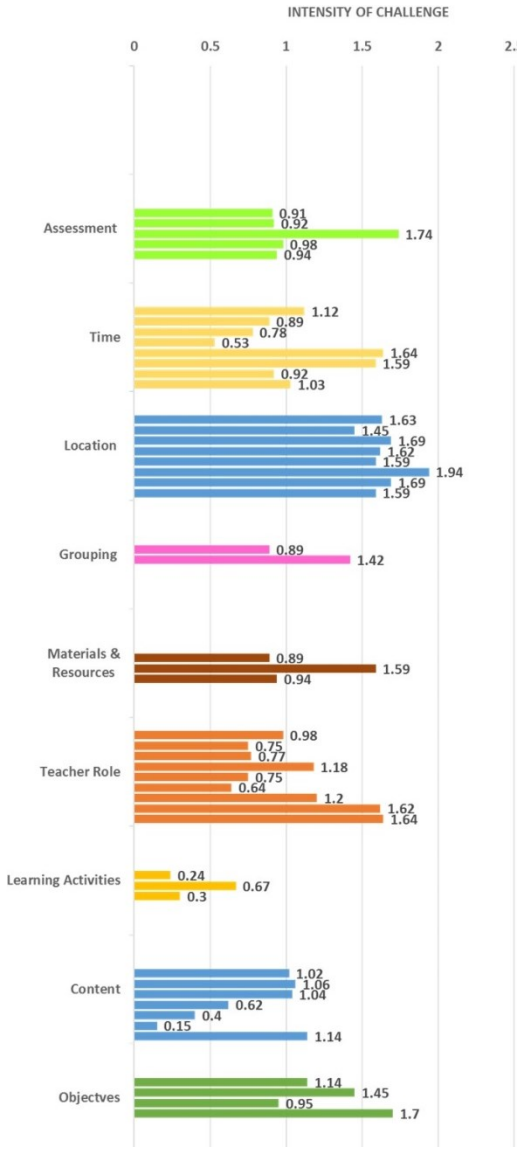

Fig 2. Intensity Challenges of Architectural Engineering Curriculum Components (Source: Authors)

The results of the analysis showed that from the perspective of professors of architecture in universities across the country, the undergraduate curriculum, which was revised by the University of Tehran in 2013, faces challenges in all nine Components. In the following, while comparing the findings of research and related research, solutions to modify and revise the curriculum to provide vocational training in 9 Components are presented:

4.1 Objectives

The undergraduate course curriculum is challenging in Component of objectives from 9 items to 4 items; These challenges include "inconsistency between the objectives of the curriculum with the predicted educational facilities", "incomplete achievement of the set objectives", "unattainability of the set educational objectives during the implementation of the curriculum" and "insufficient attention to interests", respectively. And the needs of students in determining educational Objectives (Table 2).

Table 2. Results of one-sample t-test (Curriculum challenges from the perspective of professors related to the objectives component) (Source: Authors)

one-sample t-test			One-Sample Statistics			Tests / Items / Curriculum Components	
Sig	Df	T	Sd	M	N		
0.00	99	22.24	.44	4.00	100	1) The objectives are clearly stated in the curriculum.	Objectives
0.00	99	-23.13	.49	1.84	100	2) "Training of efficient professional graduates" can be achieved as educational objectives set during the implementation of the curriculum.	

0.00	99	-27.80	.61	1.30	100	3) There is a fit between the objectives of the curriculum and the educational facilities provided in it.	
0.00	99	-28.82	.32	2.05	100	4) In determining the educational objectives in the curriculum, the interests and needs of students have been taken into account.	
0.00	99	10.66	.6	3.65	100	5) The objectives set in the curriculum are commensurate with the needs of the labor market.	
0.00	99	13.09	.56	3.78	100	6) There is a fit and coordination between the objectives of the course with the general objectives of the field (Vocational Education).	
0.00	99	19.06	.54	4.03	100	7) In the set objectives, the relationship between the university and the professional professions has been considered.	
0.00	99	9.75	.5	3.49	100	8) In the set objectives, attention has been paid to the professionalization of architecture education in order to empower students in professional fields such as design, supervision and execution.	
0.00	99	-23.79	.6	1.55	100	9) Empowering architecture students to pursue professional careers as a goal emphasized in the curriculum has been fully realized.	

Due to the role of the objective Component in directing and giving meaning to other Components of the curriculum, it is necessary to establish a balance between the objectives of the curriculum and other Components (such as Learning activities, time, content, etc.).

The full realization of the educational objectives set in the curriculum and the achievement of "efficient specialist training" requires practical solutions for the professional training of architecture students. In the meantime, new and practical approaches can be used in curriculum development such as "practice-based education" [20], [19] [18], [22] and [21].

Addressing the "practice-based education" approach in the curriculum of the undergraduate course in architecture has provided the basis for vocational training in the education of architecture students, which is important in the fifth development plan of the country (approved in 2005 and 2010) as technical and vocational training and the High Planning Council. (Approved in 1998, 2005, 2013, and 2016) in which the undergraduate course in architecture is defined as professional courses; Other researchers such as Akrami (2003), Tafazli (2017), Farzian and Karbasi (2014), Razzaqi Asl (2011), Qudusifar et al. (2012), Alaei (2001), Sedaghati and Hojjat (2017), Ali Al-Hesabi and Nowruzian Maleki (2009), Shariat Rad and Mahdavipour (2008) and Hojjat (2012) have each considered this general policy and the purpose of teaching architecture in the undergraduate course is to prepare for professional work.

International documents submitted by the International Union of Architects (UIA, 2011), the European Association for Architectural Education (EAAE, 2012), and a document submitted by UNESCO (2011) for the teaching of architecture are all intended to provide a training structure for vocational education to students. Since employment is one of the consequences of vocational education, it will also lead to sustainable social development at a higher level. This is in line with international documents (UNESCO, 2015) and the mission of fourth-generation universities that are work-based. Other globally researched studies have introduced helping to create jobs by developing students' professional abilities in the future as one of the basic principles of university work [18].

4.2. Content

In the content Component, from 10 items to 7 items, the curriculum is challenged. These challenges include "lack of attention to the knowledge and characteristics of the audience in setting the content", "not providing the necessary preparation of graduates for professional activities", "low content flexibility in proportion" Knowledge of the day "," Low proportion of content with the length of the 4-year undergraduate course "," Inadequacy of the number of courses with the volume of content "," Imbalance between theoretical and practical aspects of content "and" Low educational content ability to encourage students to learn Are active (Table 3).

Table 3. Results of one-sample t-test (Curriculum challenges from the perspective of professors related to the content component) (Source: Authors)

one-sample t-test			One-Sample Statistics			Tests / Items / Curriculum Components	
Sig	Df	T	Sd	M	N		
0.00	99	-18.89	.6	1.86	100	10) In setting the educational content, attention is paid to the knowledge and characteristics of the audience.	Content
0.00	99	14.9	.56	3.84	100	11) The necessity of the specified content is clearly stated.	
0.00	99	15.11	.5	3.77	100	12) Educational content contains basic concepts related to the profession of architecture.	
0.01	99	-3.27	.45	2.85	100	13) encourages the student of architecture to actively learn.	
0.00	99	18.96	.52	3.99	100	14) There is a logical connection and convergence between the content of the courses.	
0.00	99	-4.69	.85	2.6	100	15) There is a balance between theoretical and practical aspects in the content of the curriculum.	
0.00	99	-9.13	.67	2.38	100	16) In the curriculum, there is a fit between the volume of content and the number of units of courses.	
0.00	99	-19.61	.53	1.96	100	17) Content is flexible to fit current knowledge.	
0.00	99	-17.19	.61	1.94	100	18) Content provides the necessary preparation for professional activities.	
0.00	99	-17.41	.58	1.98	100	19) The volume of curriculum content is commensurate with the length of the 4-year undergraduate course.	

In order to improve the curriculum in content development, different components and angles should be considered in planning so that the presented content can cover the set objectives. Paying attention to the characteristics of the audience, creating readiness for professional activities, and being in line with current knowledge are among the factors that should be paid special attention to in compiling the content of the curriculum. Regarding the nature of educational content and what architecture students should learn, Hojjat (2012) in his research on teaching architectural design emphasizes real issues, in real places and for the real employer. Shahamat and Nadimi (2019) also criticized the non-implementation of Architectural designs; These conditions of university education in architecture are not unique to Iran. In the fourth chapter of Grout and Wang (2005), the unreality of university architecture projects and the prevailing atmosphere of architecture schools, and pure and formal art trends in architectural projects are criticized.

International documents submitted by the International Union of Architects (UIA) and UNESCO for the teaching of architecture in 2011; An explicit recommendation for solving the problems of human societies is to use real issues in projects and research in schools of architecture so that the proposed solutions can help solve the problems of human societies. The results of Farzian and Karbasi (2014) research also emphasize that the content of education in the early years of architecture education should be comparable to jobs related to the profession of architecture; And as architecture students gain knowledge, their skills will gradually approach the skills required in the profession of architecture.

4.3. Learning activities

Due to the challenges in the Component of learning activities (3 items out of 7 items in Table 4) to improve the curriculum, these activities should be provided in a way that is related to different learning styles so that students are trained with four characteristics: active, thoughtful, theorizing and pragmatic. These four features are based on the theory of Kolb (1984) in experiential learning. In this theory, experience is the source of learning and growth and experience means the interaction between the learner and the environment so that the learner realistically experiments in the environment. According to Kolb's theory, architecture students in the pragmatic category have also been shown to be more capable of solving architectural problems [36]. Therefore, this method is considered suitable for learning practical knowledge such as architecture and is consistent with the results of Noghrekar and Dejpsand's (2018) research.

Table 4. Results of one-sample t-test (Curriculum challenges from the perspective of professors related to the component of learning activities) (Source: Authors)

one-sample t-test	One-Sample Statistics	Tests / Items / Curriculum Components

Sig	Df	T	Sd	M	N		
0.00	99	15.77	.51	3.82	100	20) The curriculum combines educational and research activities.	Learning activities
0.00	99	14.57	.56	3.83	100	21) The curriculum emphasizes learning activities such as "learning by building" and "acquiring skills through work and practice."	
0.00	99	14.32	.50	3.73	100	22) There is a fit between the learning activities specified in the curriculum and the educational objectives.	
0.00	99	15.21	.47	3.72	100	23) Curriculum-defined learning activities encourage students to learn in groups.	
0.00	99	-4.02	.74	2.70	100	24) The learning activities considered in the curriculum are related to different learning styles.	
0.00	99	-11.09	.60	2.33	100	25) The learning activities considered in the curriculum engage students with research and problem-solving activities.	
0.00	99	-4.66	.51	2.76	100	26) The learning activities considered in the curriculum develop research abilities and skills.	

The place of instruction should also be adapted for experiential learning activities. According to pragmatists and the method of teaching architecture in the Bauhaus school, a classroom should provide both experimental (workshop) and experimental (laboratory) conditions for students [23]. Piaget (1896-1980) also believed in his theory of exploratory learning that the learner was more involved with objects and working directly with tangible and tangible materials; That is, they learn things through "first-hand experience" rather than through the teacher's words and phrases [34]. Roger Schank is another proponent of this view of education, which he believes wants life for actions, more action and doing than knowing. "There is only one effective way to learn how to do something, and that is to let them do it," Schank believed [37]. In confirmation of the practical activities of Farzian and Karbasi (2014), they have emphasized teaching architecture through "making".

4.4. Teacher Role

One of the least attention to the Components of the curriculum is the role of the teacher or teaching-learning strategies so that the Component of teaching strategies in most items (9 items out of 10 items in Table 5) is challenged. And the biggest challenge is related to the lack of combined use of education knowledge (pedagogy) and specialized knowledge by teachers in teaching, which requires the passage of special courses for teacher training, which should be considered at the macro level of higher education. Also, in teaching strategies, there should be an emphasis on planned teaching and the use of lesson plans by architecture professors. Regarding the key role of students and their participation in the teaching process, Cobb and Bowers (1999) in constructivist theory believe that student interaction and situations play a prominent role in acquiring knowledge and refining skills [26]. As the learning-oriented method that Vygotsky's theory forms the basis of its theory, it is known as the most important type of education based on constructivist theories [38]. Shank (2016) stated that constructive environments with a learner-centered approach are best suited for meaningful learning, with deep structure, and not for superficial understanding [26]. In constructivist environments, there is a two-way relationship between thought and action. According to Jonassen (2014), "we can not do something without thinking or we can not think without doing something" [27].

Table 5. Results of one-sample t-test (Curriculum challenges from the perspective of professors related to the component of teacher role) (Source: Authors)

one-sample t-test			One-Sample Statistics			Tests / Items / Curriculum Components	
Sig	Df	T	Sd	M	N		
0.00	99	-26.81	.61	1.36	100	27) The curriculum pays attention to the combined use of education (pedagogy) and specialized knowledge by teachers in teaching.	Teacher Role
0.253	99	1.14	.43	3.05	100	28) The teaching methods mentioned in the curriculum are appropriate to the content.	
0.00	99	-20.21	.80	1.38	100	29) The curriculum emphasizes the use of lesson plans by teachers in teaching.	

0.00	99	-19.36	.61	1.80	100	30) Individual differences have been considered in the curriculum in choosing the methods of presenting the content.
0.00	99	-9.28	.68	2.36	100	31) In the curriculum, group learning has been considered in choosing the teaching method.
0.00	99	-15.64	.47	2.25	100	32) There is a correlation between the teaching method and the technology used in the curriculum.
0.00	99	-19.36	.60	1.82	100	33) In the curriculum, attention has been paid to the use of specialized teachers in each course.
0.00	99	-15.11	.50	2.23	100	34) Curriculum teaching methods foster students' creativity and initiative.
0.00	99	-12.65	.59	2.25	100	35) In the proposed teaching methods in the curriculum, attention has been paid to providing useful feedback on students' progress by professors.
0.00	99	-20.80	.47	2.02	100	36) The curriculum pays attention to various teaching methods to understand the issues and complexities of the architectural profession.

An overview of teaching strategies in prestigious schools around the world shows that the teaching method in the National School of Fine Arts in Paris is completely dependent on eminent teachers and practical learning in studios [39]. In Germany, too, the Bauhaus School has emphasized pragmatic teaching so that the learning of architecture students is further pursued by raising real and need-based issues in the form of workshops and executive activities with real materials in real environments [39]. This similarity between the pragmatism of Dewey's ideas and the Bauhaus school of architecture will inspire the design of practice-based curricula [23]. The use of laboratory environments and performing tangible and realistic experiments emphasized in the Bauhaus school by Chakardo (2010) in the field of light, shadow, and wind in the process of teaching architectural design in Indian architecture schools have been repeated [41].

Architectural education in the United States is largely pragmatic yet realistic, with real problems and employers defined according to the needs of society [42]. In the current state of architecture education, by anticipating opportunities for experiential learning, students should be able to experience the real construction environment and perform a wide range of architectural design activities and research in it [43]. Also, in teaching strategies, in order to understand the issues and complexities of the architectural profession, it is necessary to pay attention to group learning and the use of new technology in the teaching method and foster students' creativity and initiative.

4.5. Materials & Resources

In Component of materials and resources in the curriculum of architectural engineering (revised at the University of Tehran) despite the attention to materials and educational facilities including the library, laboratory, and computer site in the curriculum But in other items (3 items out of 4 items in Table 6) from the perspective of professors of architecture is challenged so that the principles of "from simplicity to complexity" and "diversity" in the selection of materials and educational resources less attention And in a summary, the professors of architecture acknowledged that it is not possible to fully empower students' professions with the educational materials and facilities emphasized in the curriculum; Factors such as the incompatibility of the proposed materials and resources in the curriculum with the realities of the architectural profession can be considered as the cause. In this regard, research shows that one of the success factors of the traditional architecture education system is the use of real tools and activities and having a real education environment [44]. In confirmation of the real situation in architecture education, the results of more than two decades of reviewing and evaluating the activities of many architecture trainees who have received real training in the construction project while working; indicate that the trainees have gained useful experiences [45].

Table 6: Results of one-sample t-test (Curriculum challenges from the perspective of professors related to the component of materials and resources) (Source: Authors)

one-sample t-test			**One-Sample Statistics**			**Tests**
Sig	**Df**	**T**	**Sd**	**M**	**N**	**Items / Curriculum Components**

0.00	99	16.80	.45	3.76	100	37) The curriculum pays attention to the necessary materials and facilities such as library, laboratory, computer site.	Materials & Resources
0.00	99	-14.85	.63	2.06	100	38) With the educational materials and facilities emphasized in the curriculum, including the library, laboratory, computer site, etc., professional empowerment of students is possible.	
0.00	99	-24.35	.65	1.41	100	39) In choosing educational materials and resources in the curriculum, the principle of "simplicity to complexity" has been considered.	
0.00	99	-13.08	.68	2.11	100	40) In the curriculum, the principle of diversity in the choice of educational materials and resources has been considered.	

4.6. Grouping

Although the architectural engineering curriculum emphasizes teamwork in the educational environment and emphasizes the active role played by each student in the group; But 2 out of 3 items are challenged (Table 7), As the curriculum does not mention the characteristics of a suitable group workspace; Also, grouping in the educational environment based on the competencies and abilities of students in the theoretical, research and practical fields has not been considered. As the curriculum does not mention the characteristics of a suitable group workspace; Also, grouping in the educational environment based on the competencies and abilities of students in the theoretical, research, and practical fields has not been considered. In the approval of the working group in learning environments, Shank Research (2016) shows that most human learning takes place in a social environment.

Table 7: Results of one-sample t-test (Curriculum challenges from the perspective of professors related to the grouping component) (Source: Authors)

one-sample t-test			One-Sample Statistics			Tests / Items / Curriculum Components	
Sig	Df	T	Sd	M	N		
0.00	99	-24.10	.58	1.58	100	41) In the curriculum, the characteristics of a suitable working group space are mentioned.	Grouping
0.00	99	20.73	.49	4.02	100	42) The curriculum emphasizes teamwork in the educational environment and emphasizes the active role of each student in the group.	
0.00	99	-6.67	.80	2.46	100	43) The curriculum pays attention to grouping in the educational environment based on the competencies and abilities of students in theoretical, research and practical fields.	

Barab and Duffy (2000) identify pragmatic communities as the foundation for learning; And have defined community focus as the focus on skill development [46]. And it is in the social sense that it shares activities [47]. Brown, Collins, & Dugayde (1989) argue that in a pragmatic society, activity and action are not considered independent of the learning and context in which it is transmitted. According to Liu and Wegner (1991), the pragmatic community framework emphasizes the way community learns outside the classroom and has emerged through research based on traditional practical internships [27]. Accordingly, a practice-based curriculum seeks for learners to experiment in a practical environment and work communities [48]. Working with others is a key part of action-based learning. Learning with others and through others is a norm that is learned through acting with others. The practice-based curriculum relies on teamwork rather than monologue-based instruction and lecturing.

Farzian and Karbasi (2014) while emphasizing the importance of "making" in learning and teaching architecture, introduced the quality of this type of education requires "learning through group participation"; Currently, the special challenge of architecture schools is teaching professional skills, and to overcome this global challenge, Harris (2014) has suggested the presence of architecture students in the construction process in executive projects and considers the acquisition of

professional skills requires collaborative learning on-site with real examples. Rodriguez and Hudson (2016) also introduced a new training method to promote group training, in which a virtual design studio (VDS), a traditional studio, and ongoing projects at different levels are combined with a variety of tools. Lawlor et al. (2018) also introduced another practical Pattern for effective team-based learning that emphasizes the use of teamwork and technology together and has been introduced as a Pattern for the learning process in the 21st century. What matters is that projects must be applied in the real world; And guide the entire curriculum or simply scatter a series of practical activities

4.7. Location

Another Component of the curriculum that has received less attention is the Location of learning, which is challenged from 10 items to 8 items (Table 8); Because in the curriculum, the characteristics of the learning place such as "diversity and avoidance of uniformity", "simplicity and avoidance of complexity", "per capita and several classes, studios, workshops and laboratories appropriate to the number of students and characteristics of architecture", "equipping the place Learning to pay attention to software and hardware equipment appropriate to the educational objectives in line with professional activities "and" the color of spaces and places appropriate to the type of educational activity "and sometimes not even mentioned; Therefore, it is recommended to pay sufficient attention to the challenges mentioned in the curriculum and to oblige the faculties of architecture in the country to observe them.

Table 8: Results of one-sample t-test (Curriculum challenges from the perspective of professors related to the location component) (Source: Authors)

one-sample t-test			One-Sample Statistics			Tests / Items / Curriculum Components	
Sig	Df	T	Sd	M	N		
0.00	99	-21.49	.73	1.41	100	44) In the curriculum, the principle of diversity and avoidance of uniformity in the design of form and space of the educational environment has been considered.	Location
0.00	99	-26.79	.63	1.31	100	45) In the curriculum, the principle of simplicity and avoiding complexity in designing the form and educational space has been considered.	
0.00	99	21.10	.45	3.97	100	46) The curriculum pays attention to places for extracurricular activities such as a free studio, an exhibition of student works, a workshop on materials and construction, and a laboratory.	
0.00	99	-52.26	.37	1.06	100	47) In the per capita curriculum, workshops and laboratories appropriate to the field of architecture have been determined for each student.	
0.00	99	-19.74	.80	1.41	100	48) The curriculum refers to the number of classrooms and educational space in proportion to the number of students in theoretical courses.	
0.00	99	-21.62	.74	1.38	100	49) In the curriculum, attention has been paid to the appropriateness of space and software and hardware equipment in the classrooms by implementing the program and training course.	
0.00	99	-25.52	.66	1.31	100	50) In the curriculum, attention has been paid to the physical characteristics of the faculty and the desired classes, including the per capita area of space per student.	
0.00	99	-17.15	.84	1.55	100	51) In the curriculum, attention has been paid to the choice of colors of spaces and places in accordance with the type of educational activity.	
0.00	99	-21.80	.74	1.37	100	52) In the curriculum, the characteristics of special educational places for practical courses, including studios, workshops and laboratories equipped with educational materials and facilities in accordance with professional activities, are discussed.	
0.00	99	21.50	.49	4.07	100	53) The curriculum emphasizes the use of executive projects as a learning environment.	

4.8. Time

From the perspective of architecture professors, the biggest challenge of the curriculum is in the Component of learning time, so that it is challenged in all 8 items (Table 9); These challenges include "not paying attention to the proper schedule of classes during the week and the day", "eliminating the 3-hour time in workshop courses and turning them into 2-hour practical courses", "incompatibility of time with the volume of educational content", " The inadequacy of the 4-year undergraduate course (with 3424 teaching hours) to train an architect with professional ability "," the inadequacy of the time allotted for practical and theoretical courses "and" the inadequacy of the time required to repair and compensate for student learning ". There is a lot of discrepancy between the educational systems in the world about the time required to teach architecture. As in the Scandinavian countries (including the four countries of Sweden, Norway, Denmark and parts of Finland) a course lasts between 4 and 5 years and the main focus is on the artistic aspect of the field and not the technical aspect and architecture students do not have to do anything. They do not have a degree [50].

Table 9: Results of one-sample t-test (Curriculum challenges from the perspective of professors related to the time component) (Source: Authors)

one-sample t-test			One-Sample Statistics			Tests / Items / Curriculum Components	
Sig	Df	T	Sd	M	N		
0.00	99	36.45	.54	1.97	100	54) There is a fit between the time allotted and the volume of educational content.	Time
0.00	99	41.09	.50	2.08	100	55) A 4-year undergraduate course with 3424 training hours is enough to train an architect with professional ability.	
0.00	99	18.71	.75	1.41	100	56) In the curriculum, attention has been paid to the appropriate time for organizing training classes during the day.	
0.00	99	18.94	.71	1.36	100	57) The curriculum pays attention to the proper timing of classes during the week.	
0.00	99	31.49	.78	2.47	100	58) In the curriculum, there is a time for repairing and compensating the student's learning to participate in education.	
0.00	99	42.38	.52	2.22	100	59) The time allotted for theoretical lessons in the curriculum is appropriate.	
0.00	99	38.46	.54	2.11	100	60) The time allotted for practical lessons in the curriculum is appropriate.	
0.001	99	5.80	3.23	1.88	100	61) What is your opinion about eliminating the time allotted for workshop lessons and turning them into practical lessons in the curriculum?	

In countries such as Germany and Belgium where architecture is strictly legal; The architectural period is between 5 and 6 years, and the technical aspect of architecture is much higher than that of the Scandinavian countries. After completing the architecture course, students must complete at least two years of internship to obtain an architectural activity license. In the United Kingdom, the profession of architecture is legal and requires a license to operate, and obtaining it is subject to at least 5 years of training and two years of internship [50].

A look at the history of architecture education in North America showed that a standard four-year curriculum was not sufficient for undergraduate education, and that the first college to adopt a five-year architecture curriculum in 1922 was Cornell University; By 1940, almost all architecture schools had a standard five-year architecture program leading to a bachelor's degree in architecture [42]. In the 1940s, Joseph F. Hudnut (1886–1968) of Harvard University compiled a list of subjects that he thought were necessary to teach perfect architecture, so that a student would need twenty-two years to learn them all. What is clear is that this time was not practically possible to teach in the faculties of architecture, so it was announced that not

everything has to be taught in the faculty! In Iranian universities, the bachelor's degree course in architecture consists of eight semesters, which has replaced the continuous master's degree course in architecture since 1999. Commenting on the appropriate course length requires more comprehensive research to train the expected efficient professionals in the curriculum.

4.9. Assessment

In terms of assessment, the architectural engineering curriculum is challenged from 10 items to 5 items (Table 10); So that in choosing the evaluation method, students' "self- Assessment" has not been considered; And the proposed assessment methods are of little relevance to the objectives and topics presented. Also, due to the incompatibility of assessment methods with educational objectives, it can not be expected that skills appropriate to the architectural profession will be fully measured. Therefore, the assessment of students' skills and analytical ability in professional areas should be considered. And addressing the challenges mentioned in the assessment Component is expected to lead to the realization of "Training efficient specialist graduates" as the objective emphasized in the undergraduate curriculum.

Table 10: Results of one-sample t-test (Curriculum challenges from the perspective of professors related to the assessment component) (Source: Authors)

one-sample t-test			One-Sample Statistics			Tests / Items / Curriculum Components	
Sig	Df	T	Sd	M	N		
0.00	99	-22.26	.42	2.06	100	62) Evaluation methods in the curriculum are appropriate to the educational objectives.	Assessment / Evaluation
0.00	99	18.84	.55	4.05	100	63) In the curriculum, various methods of measuring and evaluating academic achievement in theoretical courses have been suggested to professors.	
0.00	99	23.66	.46	4.11	100	64) In the curriculum, various methods of measuring and evaluating academic achievement, including diagnostic, formative and final in "practical and workshop courses" have been suggested to professors.	
0.00	99	-19.92	.49	2.02	100	65) The evaluation methods proposed in the curriculum are appropriate to the objectives and topics presented.	
0.00	99	19.13	.51	3.98	100	66) In the curriculum, the principles of grading assignments in theoretical courses are clearly stated.	
0.00	99	24.40	.40	3.98	100	67) In the curriculum, the principles of grading assignments in "practical and workshop courses" are clearly stated.	
0.00	99	-25.18	.69	1.26	100	68) In choosing the evaluation method, students' "self-evaluation" has been considered.	
0.00	99	-18.94	.48	2.08	100	69) In the evaluation curriculum, the level of students' analytical power is considered.	
0.00	99	16.03	.47	3.76	100	70) The curriculum pays attention to the possibility of feedback to improve students' learning.	
0.00	99	-17.69	.51	2.09	100	71) The curriculum emphasizes the assessment of students' actual learning.	

5. Conclusion

In this study, the curriculum as the central pillar of the education process and a tool for achieving the objectives of higher education and promoting vocational training in the field of architectural engineering was examined. The study of the challenges of the curriculum, which was reviewed by the University of Tehran in 2013, showed that from the point of view of the professors, this curriculum is challenged in all nine components based on the Klein model from 42 to 100%; the curriculum

is challenged from 71 items to 49 items, At the rate of 69%, and according to figure 2 the most challenges in the nine Components are related to "learning time" (all 8 items), "teacher role" (9 items out of 10 items), respectively. "Learning location" (8 items out of 10 items), "materials and resources" (3 items out of 4 items), "content" (7 items out of 10 items), "grouping" (2 items out of 3 items), "assessment" (5 items out of 10 items), "objectives" (4 items out of 9 items) and "learning activities" (3 items out of 7 items). The curriculum is the blueprint for the architectural engineering course and given the conceptual model of the research (figure 1) and the important and key role of the objective element in it, in reviewing the curriculum, it is first necessary to modify the objectives in accordance with the identified challenges; In this regard, and considering the results of this research, it is necessary to pay attention to the following items in formulating the objectives of the curriculum in order to promote vocational training:

- Fit curriculum objectives to labor market needs;
- Maintaining the connection of the university with the professional fields of architecture, including design, supervision and execution;
- Proportion and coordination between the objectives of the course with the general objectives of the field of architecture and training of efficient professionals;
- Professionalization of architecture education in order to empower students in vocational fields;

The challenges of the architectural engineering curriculum have not yet been fully explored in all its components in Iran, and the innovation of the results of the present study compared to other researches in using the model of nine components of Francis Klein as the most famous and complete understanding of the components of the curriculum in higher education. Also, based on the conceptual model and items designed in this research, it is possible to evaluate other architectural engineering curricula in Iran (3 other curricula) in order to promote vocational training.

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