

Proactive Teaching: Development and Validation of a Scale to Evaluate Constructivist Teaching in Higher Education

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ABSTRACT

Background: Constructivist teaching is deemed beneficial across most educational contexts, and is particularly valued and utilized in tertiary settings. Yet to date, no tools have been made available for measuring and evaluating the construct. This study aimed at developing and validating a scale to evaluate the proactive teaching (based on Constructivism) in higher education.

Methods: The present research is an exploratory mixed methodology. The statistical population of the present study included all students of psychology, education, social sciences, medicine and management of University of Tehran during the 2015-16 academic years. The first phase of the research involved developing a tool within a framework of qualitative methodology and phenomenology based on semi-structured interviews collected from 100 students selected through purposeful sampling. The second phase incorporated the data collected from 500 students selected by stratified random-sampling to validate the six-dimension scale through exploratory and confirmatory factor-analysis.

Results: The result was the conceptualization of six dimensions of active learning: self-organization, constructivism, cognitive involvement, participation and cooperation, teacher as facilitator, and constructivist evaluation. The results showed that the Proactive Teaching Scale (which includes 6 components and 42 items) has adequate properties to evaluate this teaching method in higher education explaining 53.48% of the total variance. Ordinal Theta coefficient (0.86 - 0.92) indicated good internal validity.

Conclusion: The Proactive Teaching Scale provides a valuable tool to evaluate constructivist teaching, and contributes to improved teaching and learning practices in higher education.

Keywords: Proactive teaching, scale, Development, Validation, Evaluate, Active learning, Constructivist teaching, Higher education

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Please cite this paper as:
Hajhosseini M, Hosseini
Shabanan S, Naji ES, Naghsh
Z. Proactive Teaching:
Development and Validation
of a Scale to Evaluate
Constructivist Teaching in
Higher Education. Interdiscip
J Virtual Learn Med Sci.
2020;11(1):1-12. doi: 10.30476/
ijvlms.2020.84709.1014.

Received: 27-12-2019

Revised: 18-03-2020

Accepted: 19-03-2020

Introduction

In recent years, constructivism has emerged as a new approach in the philosophy and psychology of education. It has been influenced by the theories of Dewey, Piaget and Vygotsky as well as the evolution of ideas and explanatory foundations about knowledge. It has also challenged the underlying assumptions of behaviorist thoughts, and it has produced new goals and methods for education.

According to Piaget (1), learning is the process of cognitive development, which includes the making and remaking of learning experiences. This process aims to impact an individual's perception when activating his or her particular mental framework (2). They are not directly influenced by environmental information, perceptions, external or abstract experiences, or personal interpretation based on their cognitive construction (3). Therefore, learning is not the reflection or reception of the outer world derived from experience, education, or social communication. Instead, learning is an intelligent action based on the transformation and rehabilitation of cognitive organization (4).

Education is the opportunity to solve a problem in a real-life situation and have a social interaction that blends the balance of the mental framework and provides a context for continuous change, reconstruction, and adaptation within the cognitive structure. Vygotsky has expressed this theme with more emphasis on individual action in the context of social interactions. His point is that learning occurs in the mind of the active learner based on social interaction and in the context of cultural exchanges. While interacting in a community context and exchanging ideas through language, students consciously involve themselves in a learning experience. Furthermore, they try to discover their own interpretation, and use the advantage of social guidance and other people's protection to reconstruct their perception (5). Therefore, education does not simply entail the transmission of information. Instead, a problem is presented with the aim

of provoking the students to engage in solving it through cooperation and participation and establishing a new equilibrium. For instance, Vygotsky (5) provoked a student during his or her approximate range of growth.

Bruner (6) calls this process exploratory, and considers it an active process. Instead of transferring a set of facts or information by stating the problem, it engages a person in a continuous process of thinking in synchronicity with discovery, selection, representation and categorization. He this process calls conceptualization. (7). In addition Bruner, like Vigotsky, sees this process as the result of the learner's actual action in the context of social interaction in which the learner is supported by the teacher, peers, and other persons through the mediating role of language(8).

Based on this constructivism, learning is the creation of the active knowledge of the learner's experiences, the knowledge the person creates in the process of constructing meaning, and the interpretation of experiences.

According to this approach, knowledge is based on the individual experiences and personal interpretations of each individual. Therefore, it is never fully transmitted to another person; and the teacher is not the distributor of knowledge but a "Pro-active facilitator". In this approach the teacher's task is to create an opportunity for all students to act effectively. Proactive teachers do not avoid problems in learning or problems with behaviour. These teachers accept responsibility for their students' successes and failures (9). Such teachers take pride in their ability to stand by all the students in their class, not merely those who succeed. Proactive teachers understand that each student has their own strengths and weaknesses. Their challenge is to bring out the best in all students. When students present problems, proactive teachers accept responsibility for finding solutions. They recognize that schools are awash with explanations for students' difficulties, but they do not use these explanations as excuses. In this light, a classroom-based on constructivist teaching

provides opportunities for students to hone their knowledge via first-hand experiences. In these classes, students are in real-life situations, and these diverse opportunities allow different people to participate and choose the ways they participate (10).

Constructivism is based on its explanation of knowledge creation, especially the active role of the person involved in this process. In addition, it facilitates new principles and concepts, and it has created various types of research questions and experiences within the philosophy of education (11-15). By examining their possible expectations of methods, researchers have focused on identifying their disadvantages from the viewpoint of educational agents and clarifying the necessary conditions for creating active learning environments. Other groups have gone beyond the planning stage, and have presented and tested a specific pattern of instruction based on a constructivist approach. Subsequently, they studied the effectiveness of these methods in the classroom (16-19). These researchers have diverse opinions based on their areas of expertise. They commonly compare the effectiveness of this method with traditional and teacher-oriented approaches. In other words, these studies have tested their constructive-based methods and compared them to the outcomes of traditional education (20-23). Some studies have also addressed student action in the constructivist approach (24-27). However, no one has ever conducted research about presenting the criteria and useful indicators of proactive teaching in the classroom.

In fact, despite providing the theoretical principles and explanatory bases, researchers have not found that structuralism provides accurate indicators of active teaching in classroom. Furthermore, it does not have the necessary criteria to diagnose active engagement in the classroom. In other words, active educators do not use structures, criteria, and diagnostic indicators based on actual classroom activities and interactions between teachers and students despite practical, defensible explanatory bases and

the particular measurement of this kind of training. Furthermore, in the absence of this kind of scale, constructivist teaching (especially at higher levels) is limited to general recommendations. And if some of the professors utilize their creativity based on their areas of expertise, rather than trial and error, they will more actively provide students with information.

This study aimed at developing and validating a scale to evaluate the proactive teaching (based on Constructivism) in higher education.

Methods

The present research is an exploratory mixed-methodology study. The first step of the research involves a qualitative paradigm by the phenomenological method. The purpose of this step was to identify concepts and indicators for teaching based on Constructivism. Then, based on these concepts, the scale questions bank was designed.

The second step of the research involves the validation of scale, which is performed within the framework of the quantitative research method. And the questions of this step are extracted from the findings of the qualitative section. This step was extracted from the psychometric properties of the questions using exploratory and confirmatory analyses.

Data collection tool: The research tool in the first step was a semi-structured interview. In this method, we asked all the participants the same questions. However, they were free to respond in any way they choose (28). The planning of interview questions was based on a review of previous research concepts and indicators of proactive teaching in universities. Researchers corrected questions in four steps. During each step, they asked focal groups these questions and conducted a bilateral interview with students at the University of Tehran. In the second step, after coding and analysing the interviews based on the extracted components, a quantitative part of the research was developed into a

questionnaire, which was adapted to Iranian culture. They identified the proactive teaching markers in the University. This 80-item questionnaire was conceptualized in six contexts (self-organization, context, cognitive involvement, participation and cooperation, teacher facilitator, and constructivist evaluation) for planning and evaluating the active education scale. Questions were scored on a 5-point Likert scale.

Sampling: The present study was conducted in two steps. The first step was purposeful sampling. In this step, the researcher's intention was to select items with abundant information related to the purpose of the research and to provide this information (29) by simultaneously analysing the data in this step and interviewing 100 people. The statistical population of the present study included all students of psychology, education, social sciences, medicine, and management of University of Tehran during the 2015-2016 academic years. Descriptive data were about students: mean age (21.92), 49.6% of them were female, and 50.4% were male. Most of them were single (94.2%) and born in Tehran (95.7%). In the second step (i.e., standardization), 500 students at the University of Tehran who were majoring in psychology, education, social sciences, and management were randomly selected in a class. This sample group consisted of male and female students with a mean age of 23.88 and a standard deviation of 8.55. 44.2% of them were female, and 58.8% were male. All of the students were undergraduates. The admission quota was 57.7%, and the regional quota was 79.9%. About 82% of these students were taking a daily course in college. Two hundred and fifty of these students were selected for exploratory exploration, and 250 went through confirmatory analysis.

Results

First, the findings of the qualitative step were coded and subcategories and categories were developed. Then Delphi method was used to confirm the construct validity. In this section, about 80 items were produced.

Based on similarities, these six categories were obtained:

Cognitive involvement: Structuralism considers meaningful learning as the active involvement of students in developing personal knowledge. Students are actively engaged in learning through tools, methods, questions, and educational challenges. Through their perceptions, they examine their hypotheses and interpretations.

Self-Organization: According to the underlying principles of the constructivism approach, learners are active in their educational processes. Thus, students must be able to organize their cognitive activity. Through active learning, the learner is allowed to decide on ways to engage in educational activities, suggest appropriate strategies, and participate in the selection of resources, teaching methods, and evaluations.

Contextualization: Based on theories rooted in the constructivist approach, meaningful learning occurs in real-life situations. In other words, realistic situations make it possible for the desired knowledge (e.g., content, skills, and methods) to be related to real objectives and situations.

Participation and cooperation: According to social constructivism, knowledge is created via the collaboration between individuals and a social context. Communication and collaboration protect people by creating their knowledge, which enables students to interact in groups, especially through language that facilitates knowledge.

Teacher as facilitator: A constructivist teacher does not describe knowledge. Rather, he or she is a guide, partner, and facilitator encouraging students to create their own knowledge. A facilitator does not control or induce. Instead, they support and facilitate student learning by helping them question, challenge, and formulate their own hypotheses, thoughts, and achievements.

Constructivist evaluation: As mentioned earlier, the second step of the research was performed using two exploratory and confirmatory analyses. Researchers conducted an exploratory factor analysis on the matrix

of correlation coefficients obtained from the data of the sampling group. They used various rotations and limitations on the number of factors, and the loading rate of the variables on the factors of the sign. They concluded that the method of factorizing the principal components (via a varimax rotation and the minimum amount of loading on each item in the factors of 30) resulted in the extraction of 6 factors. These factors equal the results of the qualitative section, and the results of this analysis are displayed in Table 1. The value of the Kaiser-Meier-Alkin Sufficiency Suitability Index was 0.94, and the Bartlett Spread Test Index was 10207.11. This outcome is significant; it has a level of 0.0005 and a degree of freedom of 2080. According to this finding, the assumption of performing factor analysis is on the events of the grouping process. The results of factor analysis showed

that the structure of six factors had a high value of 1, which explains 53.48% of the total scale variance. This outcome is the most appropriate and simple structure for this data. It should also be noted that this pattern was obtained after twenty rotations (Figure 1).

The results of the analysis showed the following: Among items in factor analysis, 12 items (in the first and second components) and 10 items (in the third through sixth components) were appropriately loaded. In order to finalize the number of factors and form a simple structure, researchers must consider the theoretical basis and the content of the items.

Meanwhile, due to the fact that the qualitative section is built on an active learning scale, each person is assigned the six previously mentioned components (self-organization, constructivism, cognitive

Table 1: The Constructs and specific values of proactive teaching scale

Component	Eigenvalue	percent of variance Adjusted variance	percent of congestion variance
Self –Organized	25.07	38.58	38.58
Contextualization	2.68	4.11	42.70
Cognitive involvement	2.35	3.61	46.31
Participation and cooperation	1.78	2.74	49.05
Teacher as facilitator	1.50	2.30	51.35
Constructivist evaluation	1.39	2.13	53.48

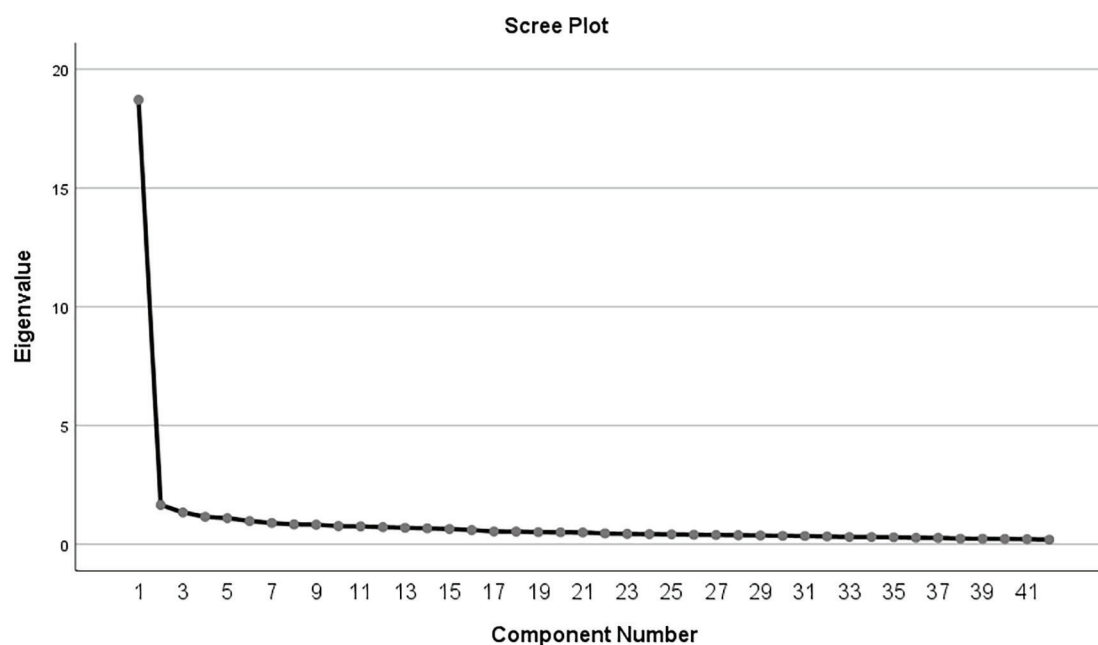


Figure 1: Scree plot

Table 2: Constructs and items in scale

Self-Organization	Contextualization	Cognitive Involvement	Participation and Cooperation	Teacher as Facilitator	Constructivist Evaluation
Students are involved in determining the appropriate method of class activities.	A part of classroom training is applied.	Classroom discussions be prioritized over engaging the students' intellectual interests.	During the educational process, the professor provides a suitable field for group activities with the same class.	The professor helps students resolve ambiguities by pointing to the unobvious aspects of the subject.	Scoring is based on students' use of theoretical concepts while solving practical issues.
Students offer their participation status in their classwork.	The professor tries to relate new topics to the previous knowledge of students.	Class discussions eventually lead to the subjective pluralization of students.	Classes try to replace competition with partnerships.	The instructor will maintain the power to provide and transmit accurate information.	More professors place attention on gaining an understanding and analysis of maintaining the content.
Evaluation methods are the results of teachers' consultations with students.	The professor consistently associates education with tangible examples.	At the end of the course, the professor directs new questions to the plan of the students, in order to study and search more.	Students are assigned to group activities, in order to help each other.	The professor provides a favorable environment and conditions for discovering the knowledge of the students.	Receiving feedback during evaluation improves training in subsequent courses.
The professor helps students become perceived via earlier knowledge with more depth.	The professor expresses the relevant examples with through their life experiences and responds to their questions.	A discussion of every new topic begins with challenging questions and discussions.	After a group activity, the professor encourages students to evaluate and critique the activities of the group.	Direct response is not given to questions, and only provides necessary guides for finding the answer.	Students participate in class discussions as evaluation criteria.
The class' current processes provides an adequate opportunity for the participation of all persons.	The professor tries to show users how to use cases in real life.	The professor encourages the criticism and evaluation of theories as an educational activity.	The professor monitors the group's activity and supervises the group.	While studying theories and methods, students are asked to provide their own inference and criticism, instead of imposing the institution's worldview.	The professor helps the class effectively achieve the best final score possible.
Professors can choose the way students contribute to classes.	Students are encouraged to apply their everyday experiences to the subject matter.	Students criticize theories, topics, and teaching methods as part of class activities.	The final score includes the tests results and class participation.	The professor introduces more resources to deepen learning.	Based on the feedback from the midterm exam, students are encouraged to amend learning methods.
Based on the professor's feedback, students can take action and choose other class activities.	One part of classroom education is finding solutions to social problems.	Students discuss and assess each other's strengths and weaknesses.	Students defend their viewpoints, which impacts their scores.	Students study the strengths and weaknesses of theories and methods with the professor and each other.	The professor guides the students towards other dimensions of the subject matter.

involvement, participation and cooperation, teacher as facilitator, and constructivist evaluation). They review the content of the items placed in each component, and show that the extracted factors from the exploratory factor analysis were consistent with these six components.

However, since the researchers initially tried to create a relatively short research tool to evaluate this structure, seven items were selected from each of the components provided that they had appropriate psychometric properties. Therefore, the final scale comprises 42 items (Table 2).

The validity of items, subscales, and the total scale in the evaluation group showed that all subscales had internal homogeneity coefficients. Their range was between 0.82 (component self-knowledge and constructivist evaluation), and 86.8% (cognitive involvement). The correlation coefficients between items and subscales also show that these coefficients are between 0.48 (items 30, 44, and 61) and 0/69 (item 39).

However, the maximum alpha elimination coefficient belongs to items 15, 26, and 62. Its minimum belongs to items 18, 19, 20, and 45. Next, composite reliability (CR) was used as measure of internal consistency of the factors, where values greater than 0.70 are indicative of good reliability. Discriminate validity is achieved when average variance extracted (AVE) is greater than maximum shared squared variance (MSV) or average shared squared variance (ASV). For convergent validity, AVE should be equal or greater than 0.50 and lower than CR. Put differently, variance explained by the construct should be greater than measurement error and greater than cross-loadings (30). For the analyses, IBM SPSS 20 was used. CR indices indicate a good reliability for all factors (all above 0.70). In addition, indices of convergent validity indicated no validity concerns; all factors AVE were less than CR and greater than 0.50. More importantly, indices of discriminate validity indicate good validity for all factors (all AVE markedly higher than MSV and ASV).

After doing an exploratory factor analysis in the sample group (for validation of the component structure), it is necessary to perform a confirmatory factor analysis of the data. Of course, it should be noted that this process involves two structures evaluated as competitive models.

These two structures were 1) the final structure of the exploratory factor analysis and 2) the one-factor structure as the basic model for assessing the diagnostic validity of the embedded components to scale.

As presented in Table 3, the first model has a total of more suitable features than the other model. Therefore, it can be concluded that the confirmatory factor structure has six components, compared to the one-component factor structure which has a more suitable fit for this data). The descriptive features of the items and their psychometric properties are presented in Table 4.

The validity of items, subscales, and the total scale of the final model showed that all subscales have suitable homogeneity coefficients (in the range of 0.58 to 0.77). Correlation coefficients of the score of the items with the total score of the subscale indicate that these coefficients vary between 0.28 (item 11) and 0.86 (item 8) (Table 4). Therefore, we can definitively say that the items, subscales, and whole scale have an intrinsic homogeneity of coefficients. To investigate the reliability we utilised R software and reported Ordinal Theta Coefficient in Table 4. Ordinal Theta Coefficient (0.86-0.92) for all factors, indicating good internal validity.

Discussion

Our research was based on the theoretical principles of constructivism, and an exploratory mixed method was presented in two steps. Therefore, a constructive teaching scale was developed and validated. According to this approach teaching is proactive; teaching that provides opportunities for students' active learning and the teacher plays a guiding role. (4, 17, 18). In these classes, students are in real-life situations, and these

Table 3: Goodness of fit measures

MODEL	X ²	DF	NC	CFI	NNFI	RMSEA	RMSEA (CI 90)	SRMSR
(1)	2048.10	804	2048.10	0.97	0.96	0.09	0.09 , 0.10	0.06
(2)	2446.86	779	2446.86	0.93	0.94	0.10	0.09 , 0.10	0.07

Table 4: Descriptive Statistics: Correlation coefficients, Means and Standard deviations, Ordinal Theta coefficient

Component	Item	Mean	S. deviation	Ordinal Theta Coefficient	Correlation between the item and subscale	Standardized path Coefficient
Self-Organization	1	2.21	1.15	0.89	0.55	1
	13	2.02	1.20		0.67	0.86
	19	1.95	1.28		0.65	0.77
	38	2.57	1.14		0.62	0.93
	44	2.54	1.13		0.58	0.89
	50	2.14	1.27		0.66	0.76
Contextualization	8	2.48	1.51	0.91	0.53	0.94
	20	2.60	1.07		0.64	0.78
	25	2.87	1.16		0.65	0.63
	30	2.50	1.20		0.62	0.78
	39	2.63	1.13		0.72	0.94
	45	2.37	1.10		0.69	0.75
Cognitive involvement	9	2.54	1.06	0.90	0.62	0.82
	15	2.46	1.13		0.63	0.67
	26	2.38	1.24		0.61	0.60
	40	2.48	1.24		0.64	0.71
	46	2.46	1.20		0.66	0.61
	52	2.38	1.21		0.70	0.71
Participation and cooperation	62	2.44	1.19		0.71	0.92
	4	2.36	1.10	0.87	0.55	0.79
	16	2.42	1.28		0.60	0.72
	27	2.38	1.14		0.65	0.68
	35	2.16	1.18		0.65	0.83
	53	2.39	1.31		0.63	0.92
59	3.28	1.21	0.44		0.93	
Teacher as facilitator	63	2.22	1.29		0.47	0.85
	17	2.65	1.10	0.86	0.60	0.67
	28	2.91	1.21		0.56	0.63
	36	2.34	1.20		0.65	0.90
	48	2.46	1.09		0.50	0.65
	60	2.42	1.15		0.65	0.66
62	2.44	1.09	0.69		0.86	
Constructivist evaluation	64	3.41	1.12		0.49	0.75
	12	2.15	1.13	0.92	0.67	0.69
	18	2.62	1.22		0.60	0.64
	24	2.29	1.29		0.54	0.97
	29	2.78	1.18		0.46	0.67
	33	2.45	1.19		0.61	0.96
37	2.07	1.17	0.63		0.94	
	61	2.70	1.11		0.61	0.87

diverse opportunities make it possible for different people to participate and choose the ways they participate (10).

The first phase of the research involved developing a tool within a framework of the qualitative research method and the phenomenology. The result was the conceptualization of the six dimensions: self-organization, Contextualization, cognitive involvement, participation and cooperation, teacher as facilitator, and constructivist evaluation.

The validation of the concepts and the standardization of the tool were obtained during the second phase. The final version of the scale was confirmed by two methods of exploratory and confirmatory analysis.

The results of exploratory factor analysis on the matrix of correlation coefficients (by two methods of causing main components, and variation of varimax) confirmed Saturation for six factors, which are most consistent with the theoretical structure to develop a scale. These six factors with value of one and more, explain 53.48% of the total variance of the scale.

The most consistent theoretical structure was considered while making the scale, and these six factors (with a high specific value of 1 in total) explained up to 53% of the total variance of the scale. The results showed that the six factors in this phase were equal to the results of the qualitative section. Since the purpose of the researchers was to construct a relatively short research tool to evaluate this structure (among the items in each of the components), seven items with the most appropriate psychometric properties and the most significant factor load were selected. Therefore, the final scale had 42 items. The validity of items, the subscales, and the total scale in the evaluation group showed that all of the subscales had intrinsic homogeneity coefficients.

Furthermore, their range was between 0.82 (self-organization component and constructivist evaluation) and 0.86 (cognitive conflict). The correlation coefficients between items and subscales also showed that these

coefficients ranged between 0.48 and 0.69. However, all factors with a Cronbach alpha coefficient above 0.8 showed good reliability of factors. Another sample was selected from the population to accomplish a confirmatory factor analysis using the data available from the reliability finding group.

During this process, two-factor structures were evaluated as competing models. The first model was the best factor structure for exploratory factor analysis. The second model was the one-factor structure, which is the basic model for assessing the diagnostic validity of the embedded component. In total, the first model was fitted with more suitable features than the second model, and the confirmatory factor structure had six components, compared to a more complex fitting model for this data. The validity of the items indicated that all subscales had suitable homogeneity coefficients (in the range of 0.58 to 0.77).

In summation, it can be said that the items, the subscales, and the total scale internal homogeneity. For making and validating the constructivist teaching scale, it can be stated that constructivist teaching provides opportunities for students to become actively engaged in gaining an understanding via a firsthand experience. In these classes, students will have real-world experiences (24-27). Also, the learners will have several opportunities to participate and to choose the method of participation (9, 17). The findings of this study equalled the findings of other research (18, 21-23). These researchers have designed, planned, and tested a method or model based on a structured approach, and compared its educational outcomes to traditional education.

Finally, the scale of proactive teaching is made necessary by the need to change the teaching process and can be effective in improving instruction and interaction in the classroom. Professors are proactive facilitators (9). They provide educational opportunities and active role for everyone, and offer a variety of methods, tools and models that enable everyone to learn.

This instruction is based on the

constructivism and emphasizes active student learning (12). Proactive teaching provides opportunities for students to actively learn through the primary experience of engaging in the knowledge construction (10).

The findings of this study are consistent with the findings (24) that proposed an instrument to measure active student learning (22, 23, 27, 28, 31, 32) that introduced an instructional design framework for active learning in higher education.

Limitations

The limitations of this research included the large number of questionnaires, the potential bias in respondents' answers, and the accuracy and clarity of the responses that may have affected validity and reliability of the questionnaires. There are also limitations regarding generalizability, and therefore, the scale should be re-evaluated in other contexts and countries in addition to larger cohorts.

Ethical Declarations

In this study, the following ethical issues were considered:

Obtaining permission from the University officials, providing explanations to students and ensuring the confidentiality of their information

Acknowledgements

We thank *University of Tehran*. We would also like to thank the students of Tehran University who participated with us during this research

Funding

This article is supplement by the research project the "*Current and Desired Status of Application of Active Education in University*" and is funded by the "*Iran National Foundation*" with additional support from the "*University of Tehran*".

Authors' contributions

M.H.H devised the study concept, designed the study, supervised the intervention, data collection and analysis, participated in the

coordination of the study, and critically revised the manuscript. S.H.SH and E.N collected data, ran the study intervention, participated in the study concept, performed the analyses and revised the manuscript. Z.N contributed to the design and analysis of the study data.

Conflict of interests

The author declares that they have no conflict of interests.

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