

Original Research



# Validating a research professionalism model for faculty members at the Tabriz University of Medical Sciences: partial least squares structural equations modeling

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## Abstract

**Background:** All researchers who carry out scientific research should consider the observance of research professionalism, which is indispensable. This study was carried out to validate a research professionalism model for faculty members at the Tabriz University of Medical Sciences.

**Methods:** The research methods used in this study were applied in terms of the research purpose and survey for data collection. The statistical population consisted of all faculty members at the Tabriz University of Medical Sciences, of whom 16 individuals were selected through purposeful sampling for the qualitative section and 260 were selected through stratified random sampling for the quantitative section. Data gathering tools included interviews and questionnaires. Cronbach's alpha and content validity were used to determine the reliability and validity of the measurement tools. The grounded theory method was used to analyze the qualitative data, and structural equation modeling (PLS) was used for the quantitative data.

**Results:** Research ethics model based on causal conditions, contextual and interventional factors, strategies, developing consequences and results of a first order factor analysis showed that the measurement models possessed composite reliability, divergent validity and convergent validity. The results of a second order factor analysis showed that structural models possessed an average or above coefficient of determination  $R^2$  as well as an above-average Q2 prediction criterion. T values were significant ( $P > 0.05$ ). Goodness of fit (GOF) was 41 (not significant).

**Conclusion:** The designed model shows both reliability and validity and an acceptable goodness of fit. Given the multidimensional nature of research professionalism, its promotion requires a systematic look at the foreground, concurrent events, consequences, and feedback on each dimension and related structures.

## Introduction

Universities are among of the most important and productive social institutions that promote creativity in society. The creation of new knowledge and its development is the responsibility of universities and academic professionals, who are rich sources of new research and knowledge of the world and its application to various issues.<sup>1</sup>

One of the most important issues in the production of knowledge is the obligations and requirements of professionalism in the higher education environment<sup>2</sup>. Observing professionalism in research is one of the basic principles of scientific writing<sup>3</sup> and plays an important role in the effectiveness of research and in enhancing the quality and credibility of scientific research<sup>4</sup>. Lack of professionalism in scientific research threatens its

stability and integrity<sup>5</sup> and can cause mistrust in research findings.<sup>4</sup> Generalizing and developing values to govern academic and professional behavior at all academic levels can increase teachers' social commitment and student confidence in academics, thus improving the health of academic communication and research activity.<sup>6</sup>

Research professionalism is a branch of professionalism that deals with ethical issues in the field of research and encompasses a vast area. Therefore, it is necessary to consider research from the decision to conduct such research to the gathering of information all the way to the dissemination of results and presentation to the scientific community.<sup>7</sup>

The incidence of plagiarism is increasing all over the world at all levels of education and at all universities (public and private), such that in various studies it has increased

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from 54% to 91%.<sup>8</sup> In *Nature* journal, a 2017 report on 58 articles published by Iranian scholars from the view point of seven scientific theories showed plagiarism and change in review or the names of authors, with plagiarism seen in 70% of these papers.<sup>9</sup> Zakir Salehi<sup>10</sup> believes that the incidence of scientific fraud in general and plagiarism in particular is very shocking and considers that it has passed the “harm” stage and has reached a crisis.

In developed countries, including England and Norway,<sup>7</sup> research professionalism is so important that research professionalism committees have been formed to monitor the research projects of faculty members and students.<sup>11</sup> The world's most prestigious journals refuse to accept papers that have not been approved by an ethics committee or have not reported providing informed consent or other ethical principles. Such requirements should lead to an improvement in observing research ethics.<sup>12</sup> Another tool now used in many countries around the world to further professionalism is the development, teaching and monitoring of ethical codes.<sup>13</sup> Such ethical codes enhance public confidence, guide professional behavior, and provide a framework for social professionalization for new members.<sup>14</sup> Thus, it is important to develop for educational institutions to develop specific ethical standards and codes, especially for faculty members.<sup>15</sup>

The United States National Institutes of Health (NIH) published its first formal definition of research misconduct in 1986; two years later, with some modifications, the United States National Science Foundation (NSF) defined these as follows: fabrication, falsification, and plagiarism and other serious deviations from the methods adopted at various stages of research such as suggestion, project, literature review, implementing and reporting.<sup>16</sup>

In a study entitled, “Ethics in Medical Research,” Guraya et al<sup>17</sup> addressed informed consent, confidentiality, privacy, privileged communications, respect, and responsibility as key elements of ethics in research, and concluded that research ethics committees must promote greater understanding of ethical issues on biomedical research at an institutional level.

Moharati and Loghmani<sup>2</sup> explicated misconduct examples associated with each step of research from the problem statement, formulation of the theoretical framework of research, scientific research design, data collection, analysis and interpretation, conclusions and writing, through presentation of results, and stated that familiarity with ethical duties in research as well as probable misconduct at each stage of the research process is the first effective step to enhancing ethical-based scientific research.

Karimian et al<sup>18</sup> conducted a study to examine research barriers and challenges from the viewpoint of Shiraz faculty members. Their results confirmed the strategic, educational, political, financial, facility, professional, scientific, individual, cultural, social, managerial and organizational barriers to research activities from the

faculty member point of view. Financial barriers were the highest, while political barriers were the lowest. However, attitudes about these barriers did not affect faculty members' research activities. Mediating variables found were “managerial insight,” “human relationships and attitudes,” and “research empowerment”.

Despite the importance of research professionalism worldwide, researches and studies within the country of Iran indicate weak performance in organizations and universities.<sup>19-21</sup> Unethical behavior has become part of the practice in some organizations, wittingly or unwittingly.<sup>22</sup> A review of the literature shows that researchers are faced with many dimensions due to the diversity of research in professionalism. However, medical faculty members' views on components and factors influencing research professionalism have rarely been studied. Accordingly, the current study was designed to examine a research professionalism model resulting from qualitative research using a quantitative approach and from the viewpoint of faculty members.

### Materials and Methods

The research methods used in this study are applied in terms of research purpose and are cross-sectional in terms of time. Data were collected using a combination of both qualitative and quantitative methods. For qualitative, the variables were identified and coded and the structural model was designed using the Grounded theory method. Quantitative collection was via survey and in line with validation of the qualitative portion, and the extracted codes from the qualitative data were used to design as a questionnaire; structural equation modeling based on partial least squares was used to measure variables and their relationships.

### Participants

Participants were faculty members of the Tabriz University of Medical Sciences in 2018. For the qualitative component, 16 experts were identified and semi-structured interviews were conducted using purposive sampling method. Inclusion criteria were at least 7 years of job experience at the university, authored at least 10 research papers, conducting at least 3 research projects and supervising at least 10 doctoral theses. Theoretical sampling continued until data saturation was reached. For the quantitative component, relative stratified random sampling was used to determine the statistical sample. The statistical population was 766 and the sample size was estimated to be 260 based on Morgan and Krejcie's table, selected from 11 faculties of the Tabriz University of Medical Sciences according to population size.

### Data collection

Semi-structured interviews were used to collect qualitative data. The interview guide consisted of several open-ended and general questions and was designed based

on objectives of the study. Interviews continued until theoretical saturation was reached. For the quantitative component, a questionnaire was created based on the extracted codes from the qualitative component. The questionnaire consisted of six scales and 129 items rated on a 5-point Likert scale (very high=5, high=4, moderate=3, low=2, very low=1). The number of items in each subscale is shown in Table 1.

### Validation

Reliability, or trustworthiness, criteria were used to validate research in the qualitative component. Trustworthiness is the degree to which one can rely on qualitative research and trust its results. Guba and Lincoln created trustworthiness criteria: credibility, dependability, confirmability and transferability.<sup>23</sup> To enhance credibility similar to the internal credibility of quantitative research,<sup>24</sup> researchers must continuously engage with the data and perform open, axial, and selective coding, the verify data with participants and non-participating experts (in this case, four). In terms of transferability, which is essentially a generalization of the results in the quantitative section,<sup>24</sup> the findings were examined by two non-participating experts who confirmed the findings by modifying irrelevant dispersions. To determine the dependability that corresponds to reliability in quantitative research,<sup>24</sup> two researchers coded the interviews separately, showing a strong agreement with the extracted results. For confirmability, similar to the validity of content in quantitative research,<sup>24</sup> analyzing negative items, reevaluating interviews and reviewing the content and its processes were done to understand a topic by asking several questions. In the quantitative component, the draft questionnaire was provided to 30 statistical experts who confirmed its face validity. The internal consistency of the items with variables was assessed using Cronbach's alpha, which was 0.8 and higher for all scales, indicating high reliability of the items in terms of variables (0.7 is considered acceptable in social sciences research).

**Table 1.** Categories, subcategories, and extracted items separately

Scale	Subscale	Items
Research Ethics	Examples of non-observance	15
	Examples of observance	12
Causal conditions	Individual	2
	Organizational	10
Environmental factors	Social	5
	Economic	2
	Internal	3
Interferer	Interferer	15
Strategies	Education	19
	Institutionalization	20
Consequences	Social	5
	Organizational	7
	Research quality	14

### Data analysis

Data analysis was performed simultaneously using the continuous comparative analysis process and in accordance with Strauss and Corbin's method in three stages of open, axial and selective coding.<sup>25</sup> In open coding, after transcribing recorded interviews, these were analyzed line by line using content analysis, and the main implications were extracted and coded. Conceptually similar codes were grouped to form initial categories. Initial codes and categories created in open coding were compared with each other and while merging similar items, categories that were related to each other were put around a common axial for axial coding, forming the dimensions of the coding paradigm. Selective coding was then performed and the qualitative research model (theory) was obtained.

First and second order confirmatory factor analysis using Smart PLS software was used to analyze the quantitative data and to measure the variables and their relationships. In the PLS method, to verify the suitability of the indicators, the model fit was studied in three parts: 1. the measurement models fit; 2. structural models fit; 3. the general model fit.<sup>26</sup>

### Results

The findings of this study include qualitative and quantitative findings. The qualitative findings are based on the analysis of the data collected from interviews and the quantitative findings were obtained from an analysis of the data obtained from the questionnaire. In the qualitative section, based on the themes derived from the analysis of the interview texts based on the continuous comparative analysis of Strauss and Corbin, as well as its paradigmatic model, the following diagram illustrates the model of research professionalism.

Based on the findings, an appropriate model of research professionalism of faculty members can be illustrated with a paradigmatic model that includes observance and non-observance of research ethics influenced by causal (individual, organizational), contextual (social, economic and internal environment), and mediating factors, and through institutionalization strategies, training and process refinement, pursues the consequences of promoting research quality and positive social and organizational consequences.

PLS software was used to answer this question and to validate the findings obtained from the qualitative part of confirmatory factor analysis. The exploratory nature of the research, the low sample size, and the great number of research questions and structures have guided researchers to use the partial least squares method, or PLS. First, they ascertained the validity of the relationships in the measurement models using reliability and validity criteria, then interpreted the relationships in the structural sector, and in the final stage the general fit of the research model was examined.

**Measurement models fit**

Three criteria, reliability, convergent, and divergent validity, were used to ascertain measurement model fit.

**(A) Reliability**

Measuring factor loadings

The reliability of the items whose factor loadings were less than 0.4 were removed from the model and the number of items was modified from the initial 129 to 68 items. The measurement model was reevaluated and the values of factor loadings are shown in Table 2. It is observed that all factor loadings are at the optimal state of more than 0.4.<sup>26</sup>

Combined reliability

In accordance with the data analysis algorithm in PLS, combined reliability is used after analyzing the factor loading to analyze the reliability of the structures. Given that the appropriate value for the reliability is 0.7 and according to the results of Table 3, the composite reliability coefficient is higher than 0.7 for all structures, these results indicate good reliability of the model.<sup>26</sup>

**(B) Convergent and divergent validity**

The second task is to check the fit of convergent validity measurement models, which is the correlation of each construct with its indexes and is shown by AVE (Average Variance Extracted). That is, the higher the correlation, the better the fit. Fornell and Larcker consider the optimal AVE value to be above 0.5. On the other hand, the AVE value of each structure should be smaller than the CR value of that structure in order to have a suitable validity model,<sup>26</sup> which, as shown in Table 3, concludes there is a validity condition for the structures in this model. Fornell and Larcker's method was used to study divergent validity, the results of which are presented in Table 3 and show that hidden variables in the model have more interaction with their indices.

**Structural model fit**

Structural model fit shows how hidden (structural) variables are linked to each other.

**A. The study of significant coefficients (T-value)**

The most important significance coefficients criterion is z, or T-value, where values greater than 1.96 indicate the validity of the relationship between constructs, and thus the research hypothesis is confirmed at a 95% confidence level. Based on the results, there is a direct and significant relationship between the constructs and the main variable.<sup>26</sup>

**B. Calculation of R2 values (effect size)**

The second criterion necessary to check the structural model fit is to study the coefficients of determination (R<sup>2</sup>) of the present endogenous (dependent) variables of

**Table 2.** Coefficients of factor loadings for each item

Variables	Components	Items	Factor loading	
Research Ethics	Examples of observing research ethics	9	0.571	
		10	0.868	
		11	0.877	
		12	0.712	
	Examples of not observing research ethics	13	0.658	
		14	0.794	
		15	0.670	
		16	0.553	
		17	0.679	
		18	0.689	
Individual	28	0.898		
	29	0.625		
	30	0.739		
	31	0.821		
Causal conditions	Organizational	32	0.655	
		33	0.797	
		38	0.504	
	Social	39	0.641	
		40	0.713	
		41	0.714	
		42	0.664	
Environmental factors	Economic	43	0.738	
		44	0.521	
	Internal	45	0.897	
		46	0.795	
		47	0.831	
		48	0.687	
Interferer	Interferer	49	0.750	
		52	0.479	
	Strategies	Interferer	54	0.577
			55	0.719
		Institutionalization	56	0.759
			57	0.718
			58	0.662
			59	0.577
Consequences	Education	68	0.703	
		69	0.654	
		70	0.660	
		71	0.679	
	Research quality	Education	72	0.686
			73	0.632
		Research quality	74	0.492
			75	0.400
			76	0.496
			77	0.473
Consequences	Social	78	0.496	
		80	0.434	
		82	0.475	
		83	0.789	
	Organizational	Education	84	0.743
			85	0.790
		Organizational	86	0.783
			104	0.408
			105	0.547
			106	0.424
Consequences	Research quality	107	0.452	
		110	0.715	
		111	0.655	
		112	0.657	
	Social	Research quality	113	0.606
			121	0.866
		Social	122	0.907
			123	0.543
			125	0.602
			126	0.541
Organizational	Organizational	127	0.780	
		128	0.653	
		129	0.593	

the model and show the effect of an exogenous variable on an endogenous variable. Values of 0.19, 0.33, and 0.67 are considered weak, moderate and strong, respectively.<sup>26</sup> According to Table 4 this value is moderate or above moderate.

**C. Calculating Q2 values**

Coefficient Q2 shows the predictive power of the model. That is, if the relationships of structures are well defined in a model, each structure can influence another's indicators and thus hypotheses can be validated.<sup>26</sup> In terms of the predictive power of the model for endogenous structures, three values of 0.02, 0.15 and 0.35 are considered weak, moderate and strong predictive power, respectively. The Q2 results were between moderate and strong.

**General model fit (goodness of fit criterion)**

After evaluating structural and measurement models, the general model (sum of structural and measurement models) should also be examined. To this end, Tenenhaus et al<sup>27</sup> introduced the goodness of fit (GOF) index. This index is calculated using the following formula, where the values of 0.01, 0.25 and 0.36 are considered weak, moderate and strong, respectively. As the value of this index approaches 1.0, the stronger the general model is considered to be. The results of the general model fit are shown in Table 5.

**Evaluating the general model of research ethics**

In accordance with the data analysis algorithm using the PLS method, after checking the fit of the structural, general and measurement models, the relationships of structures are then evaluated based on the designed model and the corresponding values of path coefficient and significance level of each pathway are tested. The indices of interest are shown in Figure 1.

Based on the significance level of variables on the structural model lines (less than 0.01), it can be said that all latent variables (components) in the model have high validity and significance. Path coefficients at a significance level of less than 0.05 in the second-order factor analysis indicate a high explanation power of the research ethics model based on dimensions derived from qualitative study and its validation in the first-order factor analysis.

**Discussion**

In order to design a research professionalism model, components and influencing research ethics were identified first by a qualitative study and then analyzed by partial squares data as a novel approach to modeling this area using structural equations. In this study, observance and non-observance of research ethics were influenced by causal conditions (individual, organizational), environmental factors (social, economic and internal environment of university) and mediating factors, and outcomes were improved (improved research quality and positive social and organizational outcomes) through the use of targeted strategies (institutional emphasis, training, and process modification). Based on the results of a confirmatory factor analysis, there is a significant relationship between the structures of each variable with the relevant one. The evaluation of the general model of research ethics indicated in Figure 2 showing that organizational factors in causal variables with a path coefficient of 0.975 and T-value of 78.21, social factors in environmental factors with a path coefficient of 0.883 and T-value of 52.41 were significant at a confidence level of 0.95, which is consistent with the studies of Daryabegian et al,<sup>28</sup> Mirzaei et al,<sup>29</sup> Abbaszadeh et al,<sup>6</sup> Karimian et al,<sup>18</sup> Adib et al,<sup>8</sup> and Farastkhah<sup>30</sup> who consider individual, environmental, and organizational characteristics as factors that influence professional ethics development.

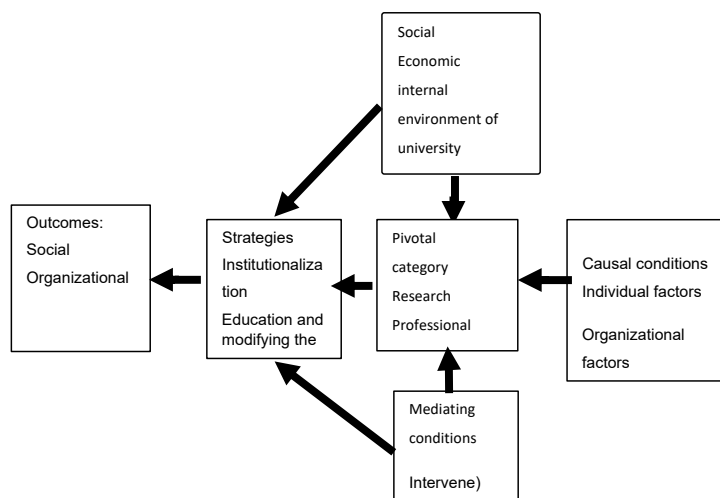


Figure 1. Qualitative research model: Research professionalism of faculty members.

**Table 3.** Results of fit evaluation in research ethics measurement model

	Variable	Composite reliability (CR)	Convergent validity (AVE)	Divergent validity
Research Ethics	Examples of non-observance	0.82	0.503	0.70
	Examples of observance	0.84	0.58	0.76
Causal conditions	Individual	0.74	0.60	0.77
	Organizational	0.74	0.50	0.70
	Social	0.805	0.55	0.74
Environmental factors	Economical	0.83	0.71	0.84
	Internal	0.801	0.57	0.75
Intervener	Intervener	0.83	0.51	0.71
Strategies	Education	0.859	0.60	0.77
	Institutionalization	0.857	0.79	0.76
Outcomes	Social	0.88	0.79	0.88
	Organizational	0.79	0.56	0.74
	Research quality	0.796	0.58	0.76

**Table 4.** Evaluation results of measurement model fit in research ethics

	Variable	t-value	R2	Q2 with predictive criteria
Research Ethics	Examples of non- observance	50.81	0.77	0.32
	Examples of observance	36.08	0.67	0.38
Causal conditions	Individual	26.11	0.58	0.32
	Organizational	78.21	0.32	0.38
	Social	41.52	0.76	0.32
Environmental factors	Economical	30.11	0.66	0.45
	Internal	10.25	0.4	0.207
	Intervener	13.69	0.2	0.157
Strategies	Education	83.1	0.88	0.5
	Institutionalization	25.29	0.95	0.28
Outcomes	Social	8/23	0.3	0.28
	Organizational	14.22	0.48	0.31
	Research quality	39.7	0.75	0.36

**Table 5.** Evaluation Results of General Model Fit of Research Ethics (Second Order)

Model Fit	Index	Variable	Research Ethics
		Average of shared values	0.246
		Average of determination coefficient	0.691
General Model	GoF value		GoF=0.41 $\sqrt{\text{Communalities} \times R^2}$

Scientific production, as one of the components of scientific societies, includes outputs and products of these societies and is one of the main indicators of scientific development of any society such that achieving this and increasing the quantitative level are the main goals of academic furtherance of knowledge.<sup>31</sup>

The results of the current study show that institutionalization with a path coefficient of 0.984 and research ethics training with a path coefficient of 0.942 are among the most useful strategies to promote research. Among the components of institutionalization, adjusting

the policies of different departments of the university, improving ethics in research rules, employing committed human forces, building culture and trust, and trusting researchers had the highest impact, respectively, with factor loadings of 0.703, 0.686, 0.679, 0.660, and 0.654. These results are in line with the findings of Hasanpour et al<sup>32</sup> as well as Farastkhah,<sup>30</sup> who emphasize the internalization of professional norms.

Among the components of education, reducing the process of approving research projects, setting up workshops, reducing pressure from research expectations,

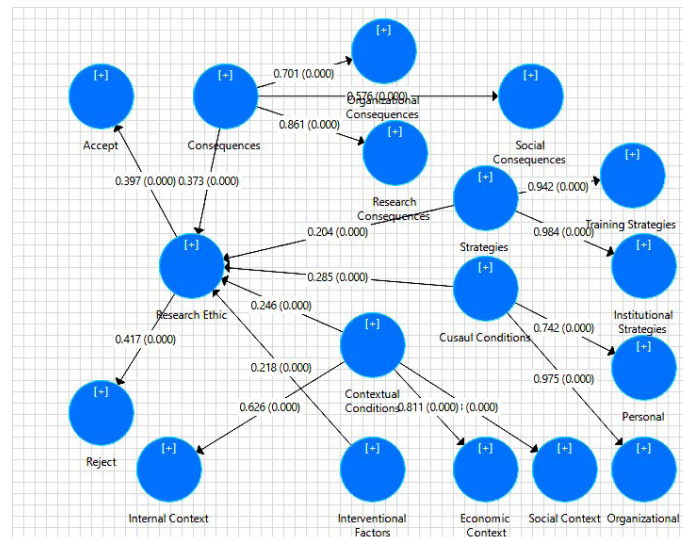


Figure 2. Significance level of components of the general model of research ethics.

and teaching students were the most effective factors, with results of 0.790, 0.789, 0.783, and 0.743, respectively. These results are consistent with the findings of Adib et al,<sup>8</sup> Feli et al,<sup>10</sup> and Karimian et al.<sup>18</sup>

Developing a sound, efficient and effective research policy requires understanding the state of the country’s research, the production of research, and the mechanisms necessary to improve and enhance research production and development, as well as the factors and criteria that affect research utilization; one of the indicators of growth and development of any country is its scientific potential. The material and spiritual growth of civilizations and human societies is dependent on research and there is a direct relationship between scientific development and the rate of research production in any society<sup>33</sup>.

In this study, the most important consequence of research ethics observance was found to be quality improvement, with a path coefficient of 0.861 and T-value of 39.7, which is consistent with the results of studies by Iman and Ghafarinasab,<sup>5</sup> Keyvan Ara et al,<sup>3</sup> and Abbaszadeh et al.<sup>6</sup>

Research ethics is a multifaceted structure and its promotion requires a systematic and comprehensive look at the foreground, concurrent events, consequences and feedback for each dimension and elements of this structure as well as related structures. The key role of research and research professionalism in fulfilling important and beneficial social and organizational consequences is considerable and requires the use of effective strategies and attention to both external and internal factors of medical universities. In explaining this finding, one must pay attention to the nature of ethics and the necessity of individual, environmental and organizational cohesion to achieve some kind of mutual, interlocking aims and values in the area of research ethics and professionalism.

Based on the findings of the study, the following suggestions are made to enhance research ethics and professionalism in academic settings:

- Offer appropriately designed and implemented courses on the principles of research professionalism.
- Require academic and educational workshops for new faculty members in terms of principles of academic and research professionalism as part of beginning their work in the academic field.
- Take into consideration professionalism criteria in addition to scientific criteria in recruiting and selecting faculty members of universities.
- Encourage ethics-oriented faculty members and provide positive contexts with the proposed model of this study to contribute to the enhancement of research professionalism.
- Provide appropriate context and conditions within the university for faculty members to interact more ethically and collaboratively.

It is suggested that a follow-up qualitative study with the participation of stakeholders in explaining research ethics may lead to new suggestions and ideas.

**Obstacles and limitations**

Of the limitations of the research, given that this study focused on faculty members and obtaining their opinions both on qualitative and quantitative researches, was that the sample studies were limited to the Tabriz University of Medical Sciences both on qualitative and quantitative researches. The study timeframe was 2018 and 2019. Therefore, it is necessary that the results be cautiously generalized to other universities. It is recommended that similar research be conducted in other provinces in order to enrich the factors and increase generalization

## Conclusion

Based on the findings, and given the multifaceted nature of research ethics, promotion of research professionalism requires a systematic and comprehensive look at the foreground, concurrent events, consequences, and feedbacks on each dimension of structure and its associated items.

## Ethical approval

This research is extracted from a PhD thesis at the Islamic Azad University, Tabriz, with ethical code of 10221212961019. In this study, ethical considerations were considered, including confidentiality, informed consent from participants, considerations of possible conflicts of interests of the participants, etc.

## Competing interests

The authors declare that there is no conflict of interest.

## Authors' Contributions

Data collection was done by MS and data were analyzed by MS and BT. The manuscript was written by MS and BT and manuscript edition was done by BT, ZDH and MA. Final confirmation of this article was done by BT and MS.

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