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Developing communities of practice model to enhance knowledge and improve learning among faculty members (Case study: Tabriz University of Medical Sciences)

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Abstract

Background: Due to the importance of the teaching and learning process in medical sciences, it is necessary to provide an appropriate context to facilitate knowledge sharing. Communities of practice (CoPs) is one strategy for sharing explicit knowledge and learning among individuals. This research aimed to develop CoPs model at Tabriz University of Medical Sciences.

Methods: This descriptive-survey research was conducted on 245 faculty members selected through a simple random sampling method at Tabriz University of Medical Sciences who had the rank of professor, associate professor and assistant professor in the 2017-2018 academic year. An exploratory factor analysis (EFA) was performed by analyzing main components that were verified by a confirmatory factor analysis (CFA). The reliability of components was calculated using Cronbach's alpha.

Results: The CoPs model consists of six components including participatory leadership, goals/aims, boundary and size, interactions, formal structures, and informal structures. There was a significant relationship observed between all components. The strongest correlations were observed between the boundary-size and interactions (0.85), goals/aims and leadership (0.78), and informal structure and leadership (0.76). In examining the relationships between each component, the strongest correlation was found between CoPs and informal structure (0.88), participatory leadership (0.87), and interactions (0.85) and the weakest relationship was observed between formal structure and CoPs (0.61). Results of determining fit indices indicated validity of the CoPs model (χ^2/df =2.69, CFI= 0.92, IFI= 0.92, NFI= 0.88, RMSEA= 0.09).

Conclusion: university managers using this model and strengthening the informal aspects of existing communities increase the possibility of faculty members' interactions from different units and having them participate in decision making related to teaching and learning processes to take effective steps towards academic development of this university.

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Introduction

Knowledge in medical universities is more important than in other organizations due to the application to health and medical education. On the other hand, considering the complexity of medical education, providing a context for sharing knowledge to overcome these complexities is complicated but equally important.

Communities of practice (CoPs) are social structures that focus on knowledge.[1] Such communities have been identified as an effective method to extract and disseminate tacit knowledge[2] and as a vehicle for learning.[3] They are effective tools for the creation and sharing of organizational knowledge, and an increasing number of organizations are adopting them as part of a knowledge management strategy.[4] These communities are used as a tool in many higher educational contexts in faculty development [5] and in teacher training.[6] CoPs have become commonplace in educational institutions as a means of bringing staff members together to discuss matters of common interest, as well as being used in educational practice itself.[7] They can guide the development of interventions to make medical education more effective and can help both learners and educators better cope with medical education complexity.[8] Learning is one of the

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most important benefits of CoPs.[9] CoPs help to improve practice of and learning about teaching.[10] CoPs' approach to teaching and learning in higher education provides a space for staff to collaboratively reflect on, review, and update current teaching and learning practices.[11] These informal teacher communities allow teachers to engage in a dialogue with colleagues and to share questions, solutions, and interpretations. These teacher communities also provide opportunities to explicate tacit expertise, which helps participants develop an idea of their own role and form a frame of reference for their own experiences.[12] The application of CoPs can potentially serve as an effective learning strategy for higher education classrooms by contributing to student professional development while fostering a desire for life-long learning.[13] The learning that occurs within CoPs is interactive.[14] Interaction between community members increases knowledge, helps access to different experiences, and improves participant's expertise. Improvements in work performance are largely due to the sharing of experiences and best practices.[9] Individuals participate in CoPs to learn practical knowledge from one another, and to accomplish shared objectives.[15]

Regarding the responsibility of medical universities in the field of education and health, as well as the diversity of educational trends and complexity of the nature of education in the field of medical sciences, having a systematic approach to health-related topics is necessary. Because it is not possible to achieve all these facets through formal education alone, creating and fostering CoPs at medical universities is an effective way to address these complex needs due to the semi-formal nature of these communities. No studies were done on CoPs at Tabriz University of Medical Sciences (TUOMS); thus researchers conducted this study and presented a native model of CoPs to provide a suitable framework to facilitate knowledge sharing and experience of faculty members at this university under different goals and conditions.

Materials and Methods

This descriptive-survey study was conducted with 245 faculty members at TUOMS in 2017-2018. This sample size was calculated based on sample selection criteria for factor analysis recommended by different authors of 5 to 10 samples for each item.[16-18] and considering a 15% dropout rate. First, the number of faculty members who had the ranks of professor, associate professor or assistant professor was assessed. Then faculty members with administrative positions, members of educational and research councils, and participants in workshops during 2016-2017 were identified, and among them 7 people per item were selected as a statistical sample. Faculty members were selected using simple random sampling.

Inclusion criteria were being a faculty member at TUOMS with the ranks of professor, associate professor, or assistant professor with more than one year of activity or instructors who were promoted to assistant professor), or who had participation in two or more workshops during the last two years, and the chancellors and managers of departments, programs, and research centers, supervisors, research directors, educational and research deputies, and research group members. There were no exclusion criteria. The data collection tool was a questionnaire that was valid and reliable in a previous published study. It was designed on a 5-point Likert scale (1= absolutely proper, 2= proper, 3= partly proper, 4= improper, 5= absolutely improper). The impact scores of items were above 1.5, with a content validity ratio (CVR) of 0.78, a content validity index (CVI) of 0.92, an α of 0.89, and an intra-class correlation coefficient (ICC) of 0.92.[19]

The justification for performing factor analysis was tested using Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity. Mardia's coefficient measurement was used to verify multivariate normality of data. The number of components was determined using exploratory factor analysis (EFA), principal component analysis (PCA) and a scree test that was described with details in a previously published study.[19] Confirmatory factor analysis (CFA) was performed in 2 steps to confirm the extracted factors, evaluate the goodness of fit indices and to develop the CoPs model. In the first-order CFA, the relation between each latent variable with observable variables was measured and the partial and general fit indices were calculated. Standard coefficients, t-values, chi-square, root mean square error of approximation (RMSEA), comparative fit index (CFI), normed fit index (NFI), goodness of fit index (GFI), adjusted goodness of fit index (AGFI), and incremental fit index (IFI) were used for determining fit indices. The most important fit index is chi-square, which shows the difference between the observable and estimated matrices. The smaller values of this statistic show the goodness of fit of model, but since this statistic is sensitive to the sample size, it is divided into degrees of freedom in high samples; a value of 2 is often considered appropriate in use of this index,[20] although some sources have suggested that the χ^2/df should be less than 3 to accept the model.[21] The IFI, CFI, NFI, GFI, and AGFI indices are placed between 0 and 1; as these values approach 1, the model is regarded as more appropriate and has goodness of fit.[17,22] In contrast, lower values for RMSEA show better fitness, so that values of less than 0.05 show good fitness, values between 0.05 and 0.08 show proper fitness, and values between 0.081 and 0.10 show average fitness.[20,23-25]

To investigate the relation between observable and latent variables and the relation between endogenous latent variables and their main constructs (exogenous variables), a second order CFA was done. The reliability of each factor was then calculated using Cronbach alpha. Data were analyzed using SPSS version 21 and LISREL 8.80.

Results

Of 245 faculty members, 230 (94%) returned questionnaires. Of the 230 returned questionnaires, 20 were dropped due

to lack of complete answers to all questions for a response rate of 86%. Despite multiple requests, 15 faculty members did not return a questionnaire.

Over half of the participants were male (58.1%). The department with the highest representation was Medicine (37%), followed by Pharmacy (13%), and then Research Centers (9%). In terms of rank, the majority (62.9%) were assistant professors (Table 1).

The KMO was 0.881 and Bartlett's test of sphericity was performed with a result of 3906.519 and $P < 0.001$, which justified performing the factor analysis. Mardia's coefficient (2.93) expressed multivariate kurtosis normality.[26] Six components were identified based on EFA, PCA and the scree plot (Figure 1 and Table 2 in a previous published study).[19] The initial structure of the extracted components was examined in terms of the content relation of items with their underlying factor based on the theoretical principles of the subject. At this stage, four items (14, 22, 25, and 26) were removed due to an insignificant relationship with a factor. The final structure of the extracted components was named according to the latent concepts in items and referring to the related research literature. The results are presented in Table 2.

Table 3 shows the partial fit indices (standard coefficients and t-values) for each component.

According to Table 2, the results indicate a correlation between observable and latent variables. The relation between each item and its related factor in all items had t-values above 1.96, indicating the significance of the relationships. In Table 4, results of calculating general fit indices of the measurement models by estimating maximum likelihood are presented.

Given the comparison of the calculated indices with the acceptable values, the validity of the evaluation scale with the measurement models is able to be confirmed.

As already stated, the CoPs model consists of six variables. The standard factor loadings and t-values were calculated to evaluate partial fit indices as presented in Figures 1 and 2.

As shown in Figure 1, there is a correlation between

Table 1. Demographic characteristics of participants

		No.	%
Gender	Male	122	58.1
	Female	88	41.9
Rank	Professor	28	13.3
	Associate professor	50	23.8
	Assistant professor	132	62.9
Department	Advanced Medical Science	13	6.2
	Dentistry	15	7.1
	Health	11	5.2
	Management & Medical Informatics	11	5.2
	Medicine	78	**37.1**
	Nursing & Midwifery	13	6.2
	Nutrition	5	2.4
	Paramedical	6	2.9
	Pharmacy	27	**12.9**
	Rehabilitation	12	5.7
	Research Centers	19	**9.0**

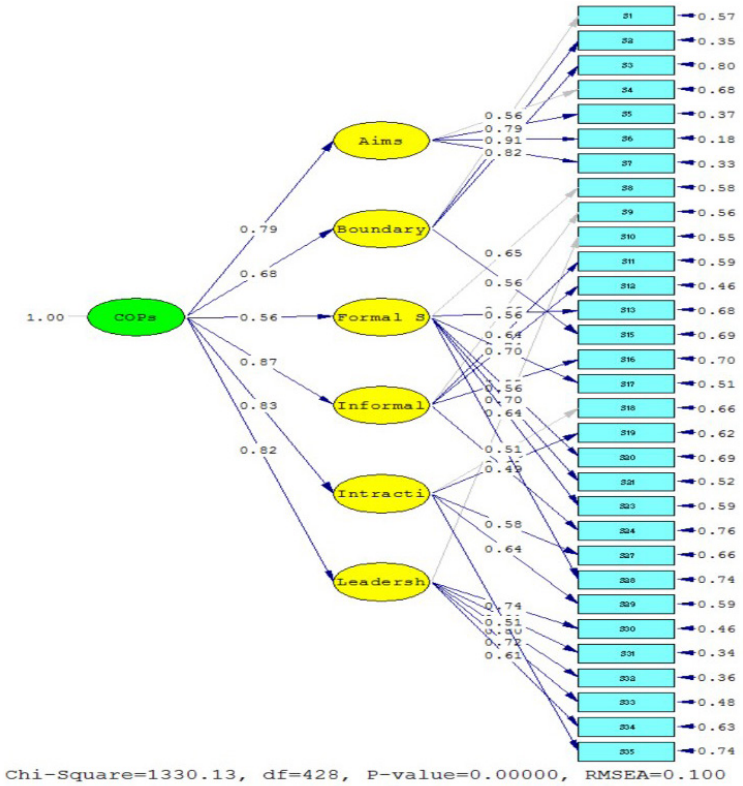

Figure 1. Standard Coefficients of CoPs Model (CFA2).

Table 2. Final structure of the extracted components

Items	Components					
	Participatory Leadership	Formal Structure	Interactions	Aims/ Goals	Informal Structure	Boundary and Size
Commitment and engagement of community of practice Leader's	0.765					
Commitment and engagement of community members	0.698					
Trust between community leaders and members	0.660					
Internal organizational facilitator	0.639					
Trust among members of CoP	0.575					
Consultation of the community leader with the members in decision making	0.566					
Establishment of CoP in top-down approach		0.709				
Determining and communicating the duties of community members by management		0.695				
The participation of members in CoP based on bureaucratic expectation		0.637				
Homogeneous members in CoP		0.568				
Membership in CoP in a continues manner		0.565				
Formal Participation of members		0.493				
Select members with specific features to attend in CoP		0.417				
Informal Participation of members			0.683			
External organizational facilitator			0.641			
A combination of voluntary and compulsory participation of community members			0.457			
Membership without limitation for them in CoP			0.442			
The interaction of members in CoP is a combination of face-to-face and virtual manner			0.381			
The aim of CoP is stewarding knowledge				0.808		
The aim of CoP is innovation and the development of initiative ideas				0.765		
The aim of CoP is to transfer of best practices and experiences among members				0.725		
The aim of CoP is to help problem solving				0.501		
Community leadership role play distribution widely among members					0.661	
Leader's friendly attitude with members and sensitivity to their needs					0.647	
The participation of members of the community in a freely and voluntarily manner					0.550	
Establishment of CoP in down-top approach					0.544	
The presence of members in CoP temporarily					0.342	
Boundary crossing of CoP within the organization						0.817
Boundary crossing of CoP inter-organizational						0.623
Boundary crossing of CoP across organizational units						0.601
Large size of CoP						0.448

observable and latent variables as well as endogenous latent variables and their main constructs (exogenous variables). The strongest correlations were seen between CoPs and informal structures (0.87), interactions (0.83), and participatory leadership (0.82), but formal structure had a weaker relation with CoPs (0.56). The results of examining the significance of the above relations are presented in Figure 2.

In Figure 2, the t-values are above 1.96 in all cases, showing significant relations between the items and their related factors, as well as between the endogenous and exogenous latent variables, which implies the appropriateness of partial fit indices.

Results of determining general fit indices of the second order CFA are presented in Table 5.

Based on results of Table 5, the validity of the CoPs model was confirmed (to achieve the optimal model, several error covariance for the items were released during modification of the model.) The CoPs model following modification is presented in Figure 3.

The results show that after modification of the model, a powerful correlation was found between CoPs and informal structure (0.88), participatory leadership (0.87) and interactions (0.85).

The results of examining the reliability of factors are presented in Table 6.

As shown in Table 6, the results for all variables were higher than the generally accepted value of 0.7, from which it can be concluded that the structures have an optimal level of internal consistency (Figure 4).[27]

Discussion

Today's successful organizations must be regarded as institutions where knowledge and skills are continually

Table 3. Standard coefficients and t-values of measuring models

Components	Items	Standard coefficients	T values
Participatory leadership	Consultation of the community leader with the members in decision making	0.64	9.87
	Trust among members of CoP	0.72	11.56
	Trust between community leaders and members	0.80	13.40
	Commitment and engagement of community of practice Leader's	0.83	13.95
	Commitment and engagement of community members	0.73	11.73
	Internal organizational facilitator	0.62	9.50
Formal structure	Establishment of CoP in top-down approach	0.68	10.22
	Determining and communicating the duties of community members by management	0.58	8.33
	The participation of members in CoP based on bureaucratic expectation	0.73	11.21
	Select members with specific features to attend in CoP	0.57	8.16
	Homogeneous members in CoP	0.69	10.47
	Membership in CoP in a continues manner	0.59	8.55
	Formal Participation of members	0.46	6.36
Interactions	A combination of voluntary and compulsory participation of community members	0.59	7.90
	Membership without limitation for them in CoP	0.59	7.96
	The interaction of members in CoP is a combination of face-to-face and virtual manner	0.50	6.62
	Informal Participation of members	0.73	9.97
	External organizational facilitator	0.52	6.83
Aims/goals	The aim of CoP is to help problem solving	0.53	7.94
	The aim of CoP is to transfer of best practices and experiences among members	0.78	12.81
	The aim of CoP is stewarding knowledge	0.93	16.54
	The aim of CoP is innovation and the development of initiative ideas	0.82	13.80
Informal structure	Establishment of CoP in down-top approach	0.63	8.92
	Community leadership role play distribution widely among members	0.68	9.68
	Leader's friendly attitude with members and sensitivity to their needs	0.77	11.28
	The participation of members of the community in a freely and voluntarily manner	0.53	7.32
	The presence of members in CoP temporarily	0.43	5.78
Boundary and size	Boundary crossing of CoP within the organization	0.74	10.08
	Boundary crossing of CoP inter-organizational	0.74	10.04
	Boundary crossing of CoP across organizational units	0.46	6.15
	Large size of CoP	0.54	7.28

Table 4. Fit indices of measuring models (CFA1)

Components	Fit indices						
	χ^2/df	NFI	CFI	GFI	AGFI	IFI	RMSEA
Participatory leadership	2.10	0.99	0.99	0.98	0.93	0.99	0.07
Formal structure	1.34	0.98	0.99	0.98	0.95	0.99	0.04
Interactions	0.69	0.99	1.00	0.99	0.98	1.00	0.00
Aims/goals	2.89	0.99	0.99	0.99	0.93	0.99	0.09
Informal structure	0.83	0.99	1.00	0.99	0.98	1.00	0.00
Boundary and size	2.52	0.97	0.98	0.99	0.94	0.98	0.08

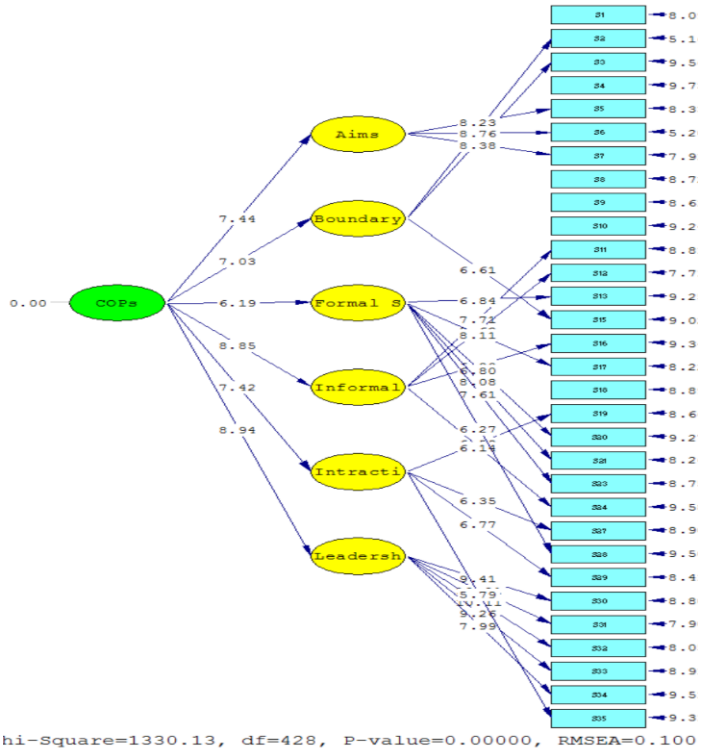

Figure 2. T-values of CoPs model (CFA2).

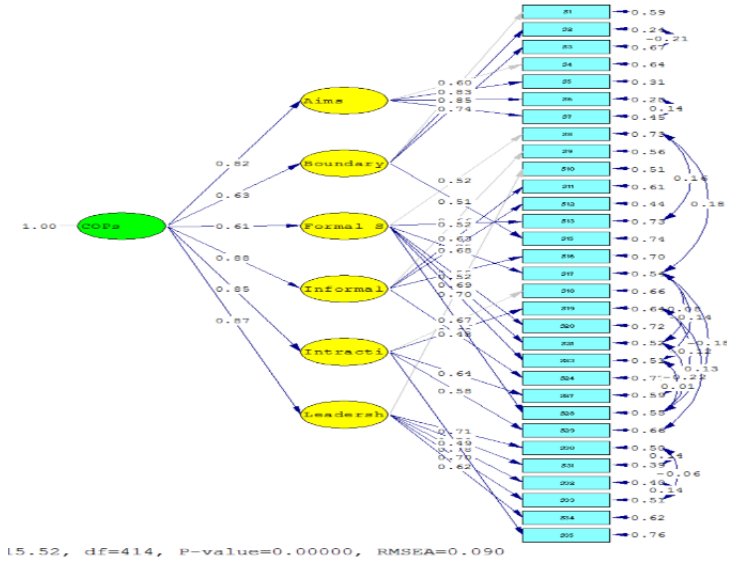

Figure 3. CoPs model.

developed, refined, updated, and protected through complex learning processes that lead to innovation.[14] This is possible by providing a suitable context that facilitates the sharing of knowledge and skills among individuals. CoPs are one such structure that enables sharing knowledge and experiences among members of an organization. Regarding attention to the importance of these communities in educational organizations, especially higher education, and taking into consideration that no previous studies were conducted in this field at TUOMS, this study aimed

Table 5. Fit indices of CFA2

Fit Indices	χ^2/df	NFI	CFI	GFI	AGFI	IFI	RMSEA
Determined amount	2.69	0.88	0.92	0.74	0.69	0.92	0.09

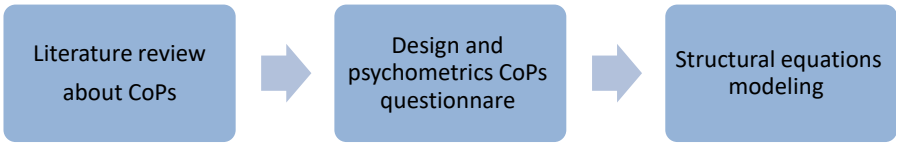

Figure 4. Study Flowchart.

Table 6. Reliability of Components

Components	Number of Items	α
Participatory Leadership	6	0.869
Formal Structure	7	0.810
Interactions	5	0.722
Aims/Goals	4	0.848
Informal Structure	5	0.738
Boundary and Size	4	0.712

to identify components of CoPs at TUOMS and to provide a native model. The important point of this study is the presentation of a novel framework. This study identified 6 components of CoPs as well as outlining the structure of CoPs. In theoretical principles and previous studies, selecting the type of structure was based on the approach of community formation by management (a top-down approach) or at the request of the members (a bottom-up approach); the results of this study showed the approach of establishing CoPs relied on many factors,[28] the style of management and leadership,[29-31] the type of participation of members (formal or informal), the way members participated (compulsory, voluntary or a combination of both), the member selection process (open or closed), as well as the presence of members (permanent or temporary) in these communities[32,33]; thus, the formal or informal nature of the structure of these communities can be determined. The results of this study demonstrated the importance of informal structures in CoPs.

Another result of this study was the boundary and size of CoPs, which in theoretical principles and, according to previous studies, were examined separately. The boundaries of CoPs are considered as places for negotiation, regeneration of knowledge,[34] promoting learning[35] and are important factors in the innovation process,[35,36] which can be inter-unit, intra-organizational, and inter-organizational. Some of these communities may be small and may include only a few experts, while others may consist of hundreds of people.[37] In all types of boundaries, people with different levels of expertise and skill through communication and interactions share knowledge and experience inter- or intra-organizationally, which leads to improved education and learning, professional skills development, performance improvement and increased trust. The size of CoPs (number of members) can be determined by the type of objective and the complexity of the issues that need to be discussed, but small communities limit ideas and experiences that are shared to solve problems and achieve other goals. Therefore, according to opinion of faculty members at TUOMS, the presence of more members from within the organization as well as from different units or other organizations is a good approach to achieve goals.

The results of this study regarding interactive processes and participation of CoPs members were congruent with the results of previous research.[32,33] All necessary aspects for the interaction of an organization members, a unit of the organization or other organizations were considered, and the unlimited presence of members in CoPs, the participation of members in the activities of CoPs both formally and informally, and their interactions into a combination of face-to-face and virtual communication, increased the desire of members to engage in the activities of the CoPs, consequently, facilitated the creation and sharing of more knowledge and experiences. The presence of an external facilitator helps facilitate the relations among the members of CoPs[7] and may be regarded as a necessary arrangement to achieve the goals.

CoPs are formed for a variety of purposes, including: to enhance problem solving, to transfer best practices and experiences, to provide stewards of knowledge, and to aid in innovation.[37,38] The results of this study provided an empirical confirmation of theoretical principles and were congruent with the results of the study of Piri.[39]

In addition to confirming the role of leadership as one of the most influential factors in the success of CoPs[30,31,37,40] this contention has been supported and confirmed by various researches. In this study, the participatory leadership style, with all its relevant features including trust between members and leader, the commitment of members and the leader, the role of leader or member of the communities as facilitator, was identified and verified as one of the most important components of CoPs. The results were congruent with previous studies about the trust between the leader and the members,[41,42] the commitment of the leader and the members,[43,44] and facilitating role of the leader in CoPs.[40,45]

Limitations

No participation of faculty members as instructors leads to non-generalizability of the results to the entire faculty. All participants were faculty members, which limits the external validity and generalizability of the results. Due to the implementation of the study at TUOMS, the results should not be generalized to other universities, but may

provide a framework for research at other institutions. It is recommended that CoPs be examined in other studies from the perspective of the faculty members who are instructors and the results be compared with the findings of the present study. It is also suggested that the role of the CoPs model on the performance of faculty members be examined.

Conclusion

Considering the complexity and sensitivity of the duties and functions of medical universities, the wide range of trends and fields of study, as well as the importance of interdisciplinary and multidisciplinary education, research, and learning in these universities, we can use the model presented in this study as a tool for facilitating the creation and sharing of knowledge, promoting learning and innovation, and improving professional skills and performance at the individual, organizational and community levels. Using this model and based on the type of objective, structure, leadership style and management, interactive practices, the level of homogeneity of individuals' specialties, and the number of members, CoPs at the university level can be created and developed.

Ethical approval

This study was approved by Ethics Committee of Tabriz University of Medical Sciences and Islamic Azad University of Tabriz (IR.IAU.TABRIZ.REC.1396.86).

Competing interests

None to be declared.

Authors' Contributions

Data collection was done by NS and the data were analysed by NS and SMA. The article was written by NS and SMA and manuscript edition was done by SMA and JYHA. Final confirmation of this article was done by SMA.

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