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Development and Validation of Self-Evaluation Tool to Assess Teaching- Strategies (SETT) of Medical Teachers: A Modified Delphi Study

Sidra Aamer, Rehan Ahmed Khan, Beenish Abbas, Fizza Sahar Anwar, Rozina Nazir, Manya Tahir

ABSTRACT

Objective: The objective was to develop and validate a tool for self-evaluation of teaching strategies for medical teachers (SETT).

Study Design & Setting: A mixed method study was conducted at Riphah International University, Islamabad, Pakistan

Methodology: A mixed method study was conducted at Riphah International University, Islamabad, Pakistan from January 15, 2019, to July 15, 2019. Modified Delphi technique was used to establish the content validity of preliminary instrument with 28 items. The response process validity was explored through cognitive interviews. Confirmatory factor analysis was done to confirm the factor model and the reliability of the tool was calculated using Cronbach's alpha.

Results: A 28-items preliminary draft instrument was reduced to 14-items final instrument after administering content validity, cognitive pretesting, and confirmatory factor analysis. Content Validity Scale was 0.97. Confirmatory factor analysis yielded a model with a good fit and an acceptable internal consistency. These statistical values signify that the tool developed has a good validity and good reliability which means that the tool rightly measured what it was supposed to measure and is reliable to evaluate the required question every time.

Conclusions: A self-evaluation tool of teaching- strategies (SETT) questionnaire is a valid and reliable instrument to evaluate teaching strategies of medical teachers.

Keywords: Quality of teaching, reliability, Teaching strategies, validity

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INTRODUCTION:

Medical education is a dynamic and continuously evolving field. Faculty evaluation is necessary to recognize the effective faculty members in teaching. It is helpful in many ways like the acknowledged qualities and strategies can be conveyed to other teaching faculty with less effective teaching skills,[1] teachers can be better assessed for promotion[2] and effective teaching will clearly improve the students learning and progress.[3] However, most of the medical teachers recieve no structured training necessary for improving their teaching strategies.[4] Many faculty members start teaching profession with no previous experience as there is no set criteria in place to evaluate their teaching effectiveness before appointment in medical institutes.[5] It is evident from literature that medical teachers improve their teaching skills through experiential learning and student's feedback.[6]

From previous studies, the success and efficiency of the teacher has always been linked with the student's progress and perceptions.[7] Medical Teachers over the years have been engaging in effective self-evaluation of their teaching strategies through a reflective and systematic approach. They have been reviewing their lesson plans, considering the learning objectives, instructional methods, and assessment tools employed. This innate introspection has enabled teachers

to assess if their strategies align with desired outcomes. However, limited literature exists which solely gauges the teaching strategies used by medical teachers. In the recent years, the drift has moved towards teacher's perceptions, self-appraisal or comprehensive self-evaluation of the medical teacher .Since teachers have a key role in the learning of students, it is very important to recognise and categorize the strategies that make them more efficient, effective and successful.[8]

The responsibility of medical colleges as institutes and the challenges faced by teachers to be accountable for the knowledge, attitudes, skills, and aptitudes of their graduates was the inspiration to conduct a study to develop a self-evaluation tool to assess the effective teaching strategies of medical teachers. The self-evaluation tool will be helpful in highlighting the strengths and weaknesses regarding performance and cultivate unused skills and abilities of medical teachers. In order to produce effective teachers, we need to recognize teaching strategies that improve learning of students. This self-evaluation will create an opportunity for medical teachers to fairly and accurately deliberate and document their performance.[9]

There is lack of standardized teaching evaluation methods for medical teachers in various medical schools. Each institute need to establish appropriate standards for effective teaching aligned with institutes vision and mission. Without standardized evaluation processes our colleges cannot accurately evaluate medical teachers.

Various researchers have added literature regarding the effective teaching strategies of school or university teachers, but it is mostly based on specific subjects like science, physics, limited studies have explored the effective teaching strategies of medical teachers.[10] Therefore, a new validated inventory is required, which will be useful for medical teachers to evaluate their teaching strategies.

The purpose of current study was to develop and validate a tool for self-evaluation of teaching strategies of medical teachers. Medical institutes may utilize this tool, for analysing the teaching strategies of their faculty and identifying the areas of self-improvement. All this development and enhancement in their teaching style may later on reflect in their students learning.

METHODOLOGY:

A mixed method study with sequential quantitative and qualitative components was conducted from January 15, 2019, to July 15, 2019 at Riphah International University, Islamabad, Pakistan. The current study involved expert medical educationists from national and international institutions. Non-probability (Purposive) sampling technique was used to meet the criteria for the 18-item inventory. Ethical approval was obtained from the ethics review board of Riphah International University, Rawalpindi (Riphah/ERC/19/0350).

The study process included by highlighting effective teaching strategies used by experienced medical teachers were identified from literature search. A preliminary draft questionnaire of 28 items was prepared for further modifications through the Delphi technique.

A 2 round modified Delphi technique was used in which 17 medical education experts were involved. An inclusion criterion was set for this panel of experts. Medical teachers having a Masters degree /PhD in medical education specifically and working in undergraduate medical institutes for a minimum of 5 years were selected as experts. All other medical teachers who were not qualified as medical educationists and had less than 5 years of teaching experience were excluded from the current expert panel. Selected experts were invited to participate through email. In round one, the panelists were asked to grade 'relevance' of items, on a five point Likert scale. Percentage responses and median scores for each item were calculated. Items with 75 percent or more response rate as extremely important or very important on Likert scale were included as per criteria defined for consensus. Items with median scores of 3.25 point or more were included for the second round as the items with median score of less than 3.25 indicates ''poor'' relevance/importance to the tool and therefore removed from the instrument.[11]

For round 2, items were added or amended based on results and the questionnaire was resent to the panellists. Panel agreement of > 75% on each statement was considered the criterion for inclusion of items in the subsequent round. Content Validity Index for the individual items (I-CVI) and of the scale (S-CVI) was computed after round 2.

Five faculty members with teaching experience of more than 3 years were randomly selected through convenience sampling for cognitive pretesting. Data was collected through individual interviews with concurrent verbal probing.[12] Four cognitive validity criteria used were 'item interpretation, clear explanation, consistent answer choice, and overall item cognitive validity' across the five participants to identify cognitive issues in the questionnaire

The final 18 item questionnaire was filled by 274 randomly selected participants, in order to determine the reliability of the final developed SETT tool. Confirmatory Factor Analysis was done to establish construct validity of the instrument by using AMOS software.

RESULTS:

The results in this section have significant statistical values which indicate good validity and reliability of this instrument. This will in turn help the instrument to become more usable and dependability of the tool will increase. Items and domains were developed during phase 1. For teaching methods 8 items, practical sessions 2 items, group discussions 2 items, questioning 2 items and for activating methods 4 items were extracted. Panellists evaluated items in each domain based on a scale of relevance using 5-point Likert scale from

'extremely important to not at all important' (5=extremely important, 4= very important, 3= moderately important, 2= slightly important, 1= not at all important).

In Round 1, 12 out of 17 (n=70%) panelists filled the preliminary questionnaire with 28 items. As suggested by the panellists, similar items were merged, new items were added, and unclear items were rephrased or excluded to develop a round 2 questionnaire. After Round 1, 4 items were removed (Item 2, 5,9 & 13), 3 were rephrased (Item 15, 16 & 28) and 1 new item (no 20) was added making a total of 25 items for the round 2 questionnaire. After round 2, 7 items (no 2, 6, 18, 20, 22, 23,24) were removed in the final questionnaire. The final tool consisted of 18 items under four suggested domains against a 4 point likert scale of always to never.

Table 1: Data analysis Round-2

Round-2: Lit of Items	**No of Agree**	**I-CVI**	**Action**
Teaching Methods			
1. I use different teaching and learning strategies to augment student's understanding	10	1.00	Accept
2. I recognize different learning styles of my students and teach them accordingly	7	0.70	Remove
3. I frequently ask relevant questions to engage learners during lectures	10	1.00	Accept
4. I define learning objectives of my lectures	10	1.00	Accept
5. I present my subject content in an organized and structured manner	10	1.00	Accept
6. I utilize demonstrations to stimulate sense of inquiry in students	7	0.70	Remove
7. I use appropriate audio- visual aids	10	1.00	Accept
8. I actively involve students in my lectures which keep them attentive and motivated to learn	10	1.00	Accept
9. I follow the timetable/ academic calendar methodically to cover the curriculum content	10	1.00	Accept
10. I utilize textbook, reference books and other online resources to make students lectures	9	0.90	Accept
Practical Sessions			
11. I provide opportunity to students for hands on activities	10	1.00	Accept
12. I give feedback on their performance	10	1.00	Accept
Group Discussions			
13. I plan structured academic activities that are relevant to students learning, based on problem solving techniques	10	1.00	Accept
14. I encourage learners to take responsibility of their own learning	10	1.00	Accept
Questioning			
15. I ask questions that stimulates students in-depth thinking	10	1.00	Accept
16. Before starting lectures, evaluates students' level of prior knowledge	9	0.90	Accept
Activating Methods			
17. I give examples to relate the knowledge with their practical applications from everyday life	8	0.80	Accept
18. I encourage students to apply what they have learned	7	0.70	Remove
19. I encourage students to think critically	9	0.90	Accept
20. I encourage peer-assisted learning	7	0.70	Remove
21. I regularly check during teaching whether students have understood the subject content	10	1.00	Accept
22. I teach students how to simplify the complex problems	7	0.70	Remove
23. I ask students to reflect on the teaching strategies	6	0.60	Remove
24. I give timely and constructive feedback to students	10	1.00	Remove*
25. I use students and faculty members feedback to improve my teaching strategies	9	0.90	Accept

Table 2: Final Questionnaire, 18 items - Experts' Responses Proportion, S-CVI/Avg & S-CVI/UA

	Ex 1	**Ex 2**	**Ex 3**	**Ex 4**	**Ex 5**	**Ex 6**	**Ex 7**	**Ex 8**	**Ex 9**	**Ex 10**
Experts' Response Scoring	79	75	83	72	76	84	86	90	87	73
Expert Proportion	0.88	0.83	0.92	0.80	0.84	0.93	0.96	1.00	0.97	0.81
Maximum Score	90									
Mean Expert Proportion	0.90									
S-CVI / Average	0.97									
No of Universal Agreements	13 (only EI & VI are considered)									
S-CVI / Universal Agreement	0.72									

Content validity analysis:

For the final 18 item questionnaire the Content validity index (CVI) on the individual item I-CVI was calculated and also of the whole scale (S-CVI), which was based on the experts' responses in second round. There are two methods for calculating the scale level CVI (S-CVI); the average calculation method (S-CVI/Avg) and the universal agreement method (S-CVI/UA). I-CVI of items after round two are shown in table 1. The Average S-CVI/Avg was calculated to be 0.90 while the S-CVI/UA was 0.56 for the Round-two 25-item questionnaire. After deletion of some items with I-CVI less than 0.75, the final 18 items questionnaire was prepared, and the S-CVI/Avg of those final selected items was 0.97 and S-CVI/UA was 0.72 as shown below in table 2:

Cognitive pre-testing:

Cognitive pretesting of the tool did not identify any significant problems in cognition, resulting in minor rephrasing of one item.

Reliability of the instrument:

The response rate was 86% (n=274/315). Internal consistency was calculated using SPSS version 21. The value of Cronbach's alpha was 0.87, indicating good internal consistency of the tool. Good internal consistency signifies that a tool is reliable to be used and will give repeated results under all conditions.

Construct validity of the instrument:

CFA was conducted to understand the internal construct of the tool through SPSS and AMOS software. Convergent validity or the construct validity refers that all the factors supposed to measure the single construct. First 2 constructs (teaching methods and practical session) were merged, third and fourth constructs (group discussion and questioning) was also merged which makes 10 items in teaching methods, 4 items in group discussion and 4 items in activating methods. Convergent validity was tested by assessing factor loadings of the items that should exceed 0.5. The second, fourth and sixth item of teaching methodology were loaded less than 0.5 and thus they were excluded. The variable initially had ten items and after removing three items it was left with seven items. Moreover, the third item of second construct, i.e., group discussion, was loaded less than 0.5 and thus after removing it the construct remained with three items. The items of activating methods had loadings in acceptable range. All the constructs of this tool had good factor loading values which signified that this tool is readily acceptable and easily understandable by the chosen respondent group.

Fit Indices of the final tool were computed and their comparisons with recommended values are shown in table below in table 3:

The final model designed pertinent to all the factors and their relevant items is illustrated below in Figure 1: Reliability of all the constructs are acceptable and given in table 4:

Table 3: Fit Indices of final tool in comparison with recommended values

Fit Indices		Recommended Cut-off value	Measurement Model
Absolute fit measures	**observed normed x^2 (CMIN/df)**	>= 5 The smaller, the better	3.136
	goodness of fit index (GFI)	< = 0.08 Near to 1	0.898
	root mean square error of approximation (RMSEA)	> = 0.1 > = 0.08	0.08
Incremental Fit measures	**normed fit index (NFI)**	< = 0.08 Near to 1	0.884
	Relative Fit Index (RFI)	Near to 1 (Higher the better)	0.851
	Incremental Fit Index (IFI)	Near to 1 (Higher the better)	0.918
	Tucker-Lewis Index (TLI)	Near to 1 (Higher the better)	0.894
	comparative fit index (CFI)	Near to 1 (Higher the better)	0.917
	Adjusted Goodness Of Fit (AGFI)	< = 0.08 Near to 1	0.849
Parsimonious fit measures	**Parsimonious Normed Fit Index (PNFI)**	The higher the better	0.690

Figure 1: Model of Confirmatory Factor Analysis

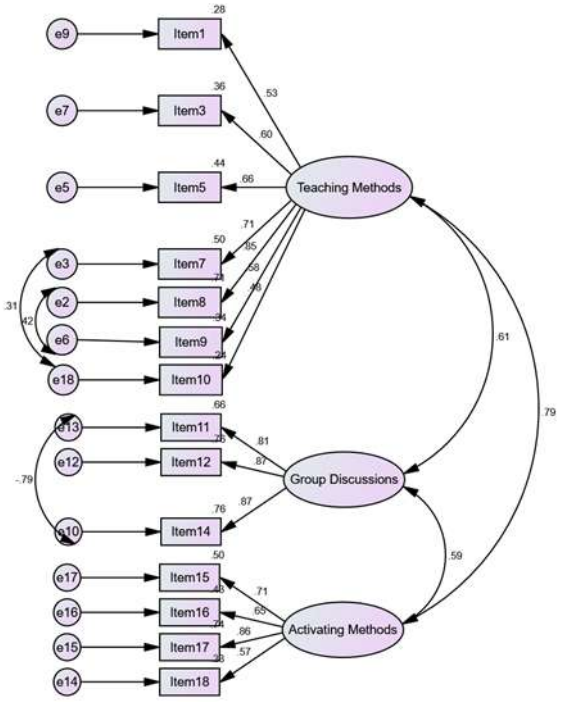

Table: 4 Reliability Analysis

Constructs	No. of Items	Cronbach Alpha
Teaching Methods	7	0.828
Group Discussion	3	0.850
Activating Methods	4	0.771

DISCUSSION:

The aim of this study was to improve the teaching skills of medical teachers. The instrument for medical faculty to evaluate the effectiveness of their teaching strategies was developed and validated through diverse methodology by conducting modified Delphi technique, content validity, pilot testing, reliability and confirmatory factor analysis. The results of current study suggest that teaching strategies of medical teachers can be evaluated using a self-administered, 14 items questionnaire, grouped into three domains: teaching methods, group discussions and activating methods.

Delphi technique shows accuracy superior to any other expert judgment methods like group discussions, conferences and other interactive group sessions.[13] We used Modified Delphi technique to establish the content validity of the instrument as it is considered the most practical and rigorous method to achieve consensus among geographically dispersed experts.[14] The experts for the study were defined as qualified (Master's or PhD degree) medical educationists with minimum 5 years teaching experience working in various private and government institutes from all over Pakistan as well as from other countries. The appropriate selection and expertise of participants included in the panel is very important as the quality of results and validity of the process of Delphi study are directly associated with it. It has been suggested that six to ten experts are sufficient, however for more stronger consensus; up to twenty experts are recommended to maintain the quality and clarity of construct.[15]

Purposive sampling was done to ensure representation from diverse group of experts. In the present study, twelve experts responded in Round 1 and ten in Round 2. The recommended group size of experts is 10-15.[16] Delphi studies use descriptive statistics or certain level of agreement of experts to measure consensus among panel of experts. These include mean, median, mode, standard deviation and percentage agreement.[17] We used a pre specified median score of = 3.25 and a consensus of experts of = 80% for all statements (Chien & Sandford, 2007). However, in various studies range of agreement level ranges from 51-80% of expert panel.[18,19]

The concept of self-evaluation and its involvement with teaching has been mentioned in literature previously. An earlier study relating self-evaluation and teaching skills of medical faculty was conducted by Pololi in 2005. This was a longitudinal study where participants from clinical faculty were enrolled in a yearlong faculty development program. The program comprised of monthly sessions and review report was taken through interviews from participants after every session. Faculty informed an improvement in self-awareness, enthusiasm for teaching and improved personal interaction with the colleagues. Whereas the present study is mixed method in which an instrument was developed in eight phases. It is a self-reported questionnaire that assesses self-evaluation through three domains.[20] These include teaching methods, group discussions and activating methods. The study by Pololi, took participants from clinical faculty where their self-evaluation of teaching skills was not assessed before beginning the program. In the present study, medical faculty from both basic and clinical sciences were included.

To determine the content validity, it is recommended to calculate I-CVIs and S-CVI of an instrument. Regarding I-CVI, values range of each item ranging from 0 to 1, where the items having I-CVI > 0.79 is taken as relevant, those between 0.70 and 0.79, were revised, and those with I-CVI below 0.70 were eliminated. There are two methods to calculating S-CVI, one is the Universal Agreement (UA) among experts (S-CVI/UA) , and the second, the Average CVI (S-CVI/Ave), the latter being a less conservative method. . Usually the S-CVI/UA = 0.8 and S-CVI/Ave = 0.9 are considered as excellent content validity. In our study all the values were in acceptable range.

Cognitive pretesting was done to achieve the 'cognitive validity' of the instrument. Interviews from 5 to 30

respondents are considered sufficient We conducted structured interviews from five faculty members using the 'Concurrent verbal probing method' as it minimizes the recall bias.

In this study, the construct validity of the developed tool was established by confirmatory factor analysis. As suggested in literature the cutoff value for good factor loading of an item is 0.5 and is followed in this study. The absolute and incremental fit values of 14-factor model demonstrated an overall acceptable fit[1] This tool has been validated over a rigorous process. Many tools are developed but construct and content validation is not carried out which has lead to poorly constructed and unvalidated tools available in the literature.

It is essential to measure reliability of an instrument as it evaluates the internal consistency and inter-rater reliability across the parts of a measuring instrument.Reliability is measured using Cronbach's Alpha. Minimum requirement of sample size to calculate Cronbach's Alpha is thirty. However larger sample size produces more reliable results. The sample size in our study was 274. The internal consistency of the final constructs was calculated using Cronbach's alpha for reliability. The reliability coefficient (alpha) can range from 0.00 to 1.00, where 0.00 shows that scale is full of error and 1.00 is representing an error free scale. A reliability coefficient (alpha) of 0.70 or higher is considered acceptable reliability. The reliability of present instrument with 14-items is acceptable.

Future research should be conducted to evaluate the impact of present study in improving the teaching strategies of medical faculty. The validation of the instrument in variable contexts is also suggested. The instrument can be applied on non-medical faculty or teachers with suggested amendments in their context.

CONCLUSION:

The final developed instrument is a 14 item, 4 point Likert scale. It has good validity and reliability and can be used to evaluate the teaching strategies of teachers in undergraduate medical institutes. The strength of this study lies in the Delphi process with 2 iterations between expert medical educationists, leading to better validity of the instrument as established through the content validity index and confirmatory factor analysis.

This study will be helpful in faculty development programs to achieve the requirement of improving the teaching strategies of medical faculty.

Authors Contribution:
Sidra Aamer: Conception of concept, data analysis, literature review
Rehan Ahmed Khan: Data interpretation, data collection
Beenish Abbas: Data collection
Fizza Sahar Anwar: Proof reading and discussion
Rozina Nazir: Data collection
Manya Tahir: Drafting

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