

Preparation and validation of a new questionnaire to study faculty perception of online teaching - Use of Cronbach's alpha and pilot.

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Abstract

Background: The COVID-19 pandemic has forced educators to shift to virtual online classes. Teachers being major stakeholders in the medical teaching-learning process, it becomes important to understand their perception towards this new endeavour. It will make this transition beneficial to the learners.

Objectives: To document the process of validation of a new questionnaire devised to study the perception of medical undergraduate teaching faculty towards online classes, using Cronbach's alpha, and the subsequent pilot for the same.

Results: At initial validation, Cronbach's alpha was not acceptable (0.65) for the questionnaire. One item was scored low by two validators and was removed. Three items were given poor rating for lay out, clarity and feasibility and required editing. The Cronbach's alpha after revision was 0.92 (acceptable). Pilot study was conducted. Based on the proportion of positive perception (36.4%) regarding ongoing online teaching programme, conducted on 11 teaching faculty with 10% absolute precision and 95% confidence, the minimum sample size for the main study was calculated to be 89. This was feasible from the point of view of total faculty strength.

Conclusion: Research work involving a new tool, such as questionnaire, must utilize the statistical tool Cronbach's alpha for validation, and pilot study for estimating the sample size and testing the content validity.

Keywords - Questionnaire, reliability, Cronbach's alpha, Validity, Pilot study, Medical education

Introduction

The COVID-19 pandemic created a situation wherein regular teaching in classrooms was considered dangerous. For nearly two years regular classrooms had to be held in online mode for the personal safety of both the teacher and the learner. A new method of teaching was required. Most educators at that time felt that e-learning only supplements conventional classroom learning^[1]. Distance education, which was an option for the less privileged, took centre stage. E-learning once considered to be "just another method of learning" has become the order of the day. Zoom, Google classroom, and other such platforms seemed to be viable alternatives to physical classes. Most teachers and students were under-prepared and had

to adjust to these new methodologies of teaching-learning.

Our institute changed to this modified system of learning. At the medical education department (MEU), we received various impressions about the perception of this teaching mode from numerous faculties. The general impression was that the junior faculty were relatively comfortable while the senior faculty had issues adjusting to this modality. We conducted a study to assess the perception of students towards online teaching and published these results^[2,3]. Our next aim was to assess the perception of online teaching modality from the point of view of the faculty. A decision was made to make a questionnaire with this aim in mind. The next step was to validate

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the questionnaire and to conduct a pilot study. Evidence suggests that the evaluation of instruments in the field of health must be multi-professional^[4]. The present article discusses this process including learning experience with the use of Cronbach's alpha.

Materials and methods

The intent was to prepare a questionnaire-based study with an in-depth interview from the medical education department of a major medical college and research institute in South India. Our institution is deemed to be a university with an intake of 100 medical students each year.

This study was exempted from the Ethics Committee review as it belonged to one of the exceptions viz. 'Comparison of instructional techniques, classroom methods and curricula', in accordance with Section 4 (sub-section 4.8) of the ICMR (Indian Council of Medical Research) Guidelines for Biomedical Research.

We started the pilot process in September 2020. The initial tool had a total of 17 items at the pre-validation stage. Appendix 1 gives details of the initial questionnaire.

Eight members of the Medical Education department (MEU) were divided into three groups of 3,3, and 2

each. The first group was tasked to discuss and make broad categories and questions that would be used in the conduct of the study (Table 1).

Table 1: Categories and information sought.

	Main category	Information sought
1	Familiarity	Any awareness or practice with online teaching-learning methods?
2	Diff. b/w Offline and Online	Perceptions about the differences between traditional teaching (physical classes and books) and present distance / online teaching
3	Anticipation / Preparation	Early planning by self or in Department for the new modality
4	Comfort factor	Perception of ease and comfort of conducting online classes
5	Issues with clinical/ practical classes	Were any Clinical / Practical classes taken? If No, Dept. decision? If Yes, perception of effectiveness
6	Issues with Assessment	Perception about the reliability of sessional theory exam method
7	How to improve / Future	Whether looking forward to continuing this? If Yes, then thoughts on improving

Table 2: Points given by one validator for content and relevance of the questionnaire.

Question number	Content				Relevance of Question 1= not relevant 2= somewhat relevant 3= relevant 4= very relevant	Total
	Readability	Layout and style	Clarity of wording	Feasibility		
	For each of the four items, mark score from 1-5. 1 is minimum and 5 maximum points					
Question 1	5	4	5	5	4	23
Question 2	5	5	5	5	4	24
Question 3	5	4	5	4	3	21
Question 4	5	4	4	4	3	20
Question 5	5	4	5	4	3	21
Question 6	5	4	5	5	4	23
Question 7	5	4	4	2	1	16
Question 8	5	4	4	4	3	20
Question 9	5	4	4	4	3	20
Question 10	5	4	4	3	2	18
Question 11	5	3	4	3	2	17
Question 12	5	3	3	4	3	18
Question 13	5	4	5	3	2	19
Question 14	5	5	5	5	4	24
Question 15	5	5	5	5	4	24
Question 16	5	4	5	5	4	23
Question 17	5	5	5	5	4	24

The second group was tasked with refining and editing the questionnaire. They were asked to ensure face validity for the tool being created. The third group was instructed to answer the questionnaire and to opine on two aspects of each question: content and relevance. To test content validity, 4 parameters were considered: readability or language, layout and style, clarity of framing, and feasibility. Each of these parameters was assigned 5 points; 1 least and 5 maximum. Alignment with objectives or relevance of the questionnaire was given 4 points; 1 being not relevant, 2 somewhat relevant, 3 relevant, and 4 very relevant. (Table 2). Hence a maximum of 24 points was assigned for each item.

For testing content validity, the questionnaire was also distributed to 3 other faculty from the curriculum committee (CC) making a total of 5 validators (two from MEU and 3 from CC). Each of these faculty was given a word document having the questionnaire and an excel file to rate the questions. (Table 2).

The data received was compiled into one single excel file. Based on the result of the Cronbach alpha, the questionnaire was modified. This resulted in editing 3 questions and deleting 1 question. Thus, the final questionnaire had 16 items. The validation process was done again for this revised questionnaire. This was then used as the tool to conduct the pilot study. The tool was administered

using Google forms. Our institution had a total of 98 faculty involved in undergraduate teaching. Literature suggests that pilot study should have about 10% of this number to assess the validity of the sample both in terms of accuracy and significance^[5,6]. Hence, we decided to include eleven (11) faculty members for our pilot. Purposive sampling was done such that they represented different departments and phases of the undergraduate medical curriculum. This included Assistant, Associate, and Professors having teaching experience ranging from 2 to 18 years, with 5 having undergone training in teaching methodologies. Senior residents were not included.

The findings of the pilot study, along with the proposal for the main work, were presented in the IRB (Institutional Review Board). The Scientific Committee approved the work and gave directions to begin the project work.

Results

Two of the validators felt that question 7 was redundant and did not add anything further to the study (rating of 1 for relevance). They also gave a low rating for the feasibility of the question. Questions 10, 11, and 13 were also rated lower for layout, clarity, and feasibility by three of the five validators for the initial tool (Tables 2,3). These questions needed editing for layout, clarity, and feasibility.

Table 3: Validator scores, Correlation coefficients, and correlation matrix for calculating the Cronbach's alpha

Validators	MEU1	CC1	MEU2	CC2	CC3
Question 1	23	22	24	23	24
Question 2	24	24	24	24	24
Question 3	24	24	24	21	21
Question 4	22	24	24	20	22
Question 5	24	24	24	21	24
Question 6	23	24	24	23	24
Question 7	21	23	17	16	22
Question 8	24	24	24	20	24
Question 9	24	24	24	20	22
Question 10	23	24	17	18	23
Question 11	23	24	17	17	23
Question 12	24	24	24	18	23
Question 13	23	24	17	19	21
Question 14	24	24	24	24	21
Question 15	24	24	24	24	23
Question 16	24	24	24	23	23
Question 17	24	24	24	24	22
Correlation coefficient		0.439564	0.599041	0.560843	0.133834
			0.079536	0.028692	-0.20145
				0.725267	0.235934
					0.157244

Correlation Matrix							Mean R Calculation
	MEU1	CC1	MEU2	CC2	CC3		
MEU1	1	0.439564	0.599041	0.560843	0.133834		0.439564168
CC1	0.439564	1	0.079536	0.028692	-0.20145		0.599040807
MEU2	0.599041	0.079536	1	0.725267	0.235934		0.560843146
CC2	0.560843	0.028692	0.725267	1	0.157244		0.133833672
CC3	0.133834	-0.20145	0.235934	0.157244	1		0.079535595
							0.028691791
							-0.201453186
							0.72526702
							0.235934244
							0.157243705
						Mean R	0.275850096
						N	5
						α	0.655724175

Points given by the five validators for each of the criteria were added and taken as a single table to calculate Cronbach's alpha. Cronbach alpha calculation points and correlation coefficients are shown along with the correlation matrix in Table 3. Cronbach alpha at this stage was 0.65, which was not acceptable. The Cronbach's alpha after the revision was found to be 0.92 which was acceptable.

Table 4: Pilot study results.

Criteria studied	Option 1	Option 2	Option 3	Option4
Online classes best suited for	Theory only	Practical only	Theory and Practical	Not sure
	63.6%	0%	18.1%	18.1%
Level of satisfaction with the online classes	Least satisfied	Moderately satisfied	Satisfied	Highly satisfied
	0%	18.1%	72.7%	9.09%
Factor that worried you the most during online classes	Video being misused	Audio being misused	Computer getting hacked	Phishing and virus threats
	27%	0%	9.09%	9.09%
Enabling video by students during online classes	Should enable	Can enable	Students can decide	Need not enable
	36.3%	18.1%	36.3%	9.09%
E-teaching takes more time than conventional classroom teaching	Yes		No	
	45.45%		54.54%	
Prefer to continue with the online classes in the present form in future	Yes		No	
	9.09%		90.09%	

Table 4 shows the results of six important items about perception by the faculty selected for the pilot study. Most faculty (60%) felt that online teaching is good only for theory classes but not for practical and takes more time than conventional classes in terms of preparing and ensuring content delivery (54%). Seventy percent of the faculty expressed satisfaction regarding online classes. Nearly all the faculty (90%) wanted to go back to offline classroom teaching after the pandemic.

Question number 15, having Likert scaling and addressing the perception of satisfaction of the

faculty, was considered for calculating sample size and as the most important question for testing the significance of data in the main study.

Sample size estimation - Based on the proportion of positive perception (36.4%) regarding the ongoing online teaching program observed in the pilot study conducted on 11 teaching faculty, and with 10% absolute precision and 95% confidence, the minimum sample size for the main study was calculated to be 89. This was feasible from the point of view of total faculty strength.

Discussion

Many studies suggest that an e-learning platform with blended face-to-face teaching provides the ideal learning environment for medical education. This method allows for flexibility in the delivery of learning^[7]. Medical educators should become flexible and proficient in the use of these new technologies effectively to transform learning. This will ensure that the medical student has a more collaborative, personalized, and empowering experience^[8,9].

When tools are designed to validate educational material and contents in the health areas it should be able to evaluate any theme. These themes should be added by featuring proper reliability and validity. There is no single universal validation instrument for content used for educational purposes. Therefore it becomes necessary to construct, and validate, a reliable instrument for several contents in health research^[4]. This process should have a scientific basis. One such measure is Cronbach's alpha.

Cronbach described the α as "an index of equivalence and an estimate of the correlation between two random samples of items, from a universe of items, like those in the test"^[10]. It is an index of reliability for the total score of a set of measurements^[11]. The alpha takes a value of 1.0 when the total score variance is perfectly attributable to the common factors running through the test items^[12]. The idea of Cronbach alpha is to assess how one or multiple items in a questionnaire achieve validity or equivalence.

Each item in the questionnaire is scored and the scores given by all the validators are tabulated (Table 3). As part of the Cronbach calculation, we need to develop a correlation matrix between the different validators and their response to the questionnaire. The correlation matrix establishes the consistency in the response from the different validators. The consistency would drive the correlation - the higher the correlation, the higher would be the Cronbach alpha value. Each column is compared to the one preceding it using the Pearson coefficient and written down in the lower rows^[13]. Pearson correlation between variables X and Y is calculated by

$$r_{XY} = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^n (X_i - \bar{X})^2} \sqrt{\sum_{i=1}^n (Y_i - \bar{Y})^2}}$$

The first validator (first column) is hypothesised to be representing validity. Each of the subsequent columns is compared to the previous one and the one before that, till the first column is reached and correlation coefficients are written down in lower rows as shown.

(Table 3) The formulas return a value between -1 and 1, where:

- 1 indicates a strong positive relationship.
- -1 indicates a strong negative relationship.
- A result of zero indicates no relationship at all.

A correlation coefficient is a statistical measure to explain the relationship between 2 variables, in this case between 2 validators' responses to our questionnaire. We then create a matrix of the correlation between the different validators and then consider all the values on the right side of the diagonal to calculate the mean response. The mean response (\bar{r}) and the number of respondents (N) are then applied in the empirical correlation to calculate the Cronbach alpha. The standardized Cronbach's alpha is written using an intra-class correlation coefficients (ICC) formula and is shown in Table 3.

Theoretically α ranges from $-\infty$ to 1, but usually will be between 0 and 1^[14]. It is based on taking the average value of several ratings by individual validators to increase the reliability of a tool^[15]. Once the value is obtained content validity is determined. Values >0.8 indicate good reliability. When mean correlation is a fixed value, α increases with the number of items. Hence it is assumed that the reliability of the scale will be better the more items it contains.

The questionnaire may need to be edited with either removal of bad items, addition of one or more items, or major editing to achieve better alpha scores. Multiple rounds of content validity evaluations are done by subject experts. Following are values for indication of sufficient reliability: $\alpha > 0.9$ (Excellent), > 0.8 (Good), > 0.7 (Acceptable), > 0.6 (Questionable), > 0.5 (Poor), and < 0.5 (Unacceptable)^[16]. When the value of Cronbach alpha is >0.7 the questionnaire is considered reliable in assessing the research criteria.

Each item and/or the whole questionnaire can be validated. In our case, the initial value was 0.65. Editing a few items and removing one item was done as remedial. Cronbach's after the revision was 0.92. The reliability of the questionnaire as well as the internal consistency of each factor can be ensured using Cronbach alpha.

Pilot studies, although frequently done in research, are rarely documented separately in published literature. The present authors had already conducted a study on the undergraduate students' perception of online teaching and published the results^[2]. However, in the present case, there was some doubt regarding achieving an adequate sample size with regards to faculty, since there were only 98 faculty involved in undergraduate teaching. A pilot study was

planned with three specific objectives - calculate the sample size for the main study, check whether the new questionnaire tool would achieve the intended purpose, and check if the conduct of the main study was feasible.

Pilot studies have been classified based on organization, into "internal" and "external". Since there were a fixed limited number of faculties for undergraduate teaching, we decided on an internal option. It was administered to a small group of participants who were then included in the main survey also. Internal pilot mandates thorough planning at the outset, and the awareness that no change can be made after the pilot^[17,18].

Analysis of responses of the pilot showed that the primary objectives of the main study could be met. The overall conduct of the pilot also showed the feasibility of the main study that was being planned along similar lines. We obtained a feasible sample size of 87 from the pilot. The various possible interpretations of results of a pilot study have been reported by In. J. These range from termination, through degrees of modification to proceeding as such^[19]. In the present work, we could proceed to the main study without major modification of the pilot study.

Conclusions

A well-scripted validated questionnaire is necessary to undertake good qualitative research.

Cronbach's alpha is a good tool to validate the content of the questionnaire, before a pilot of the project.

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