A Medical School's Organizational Readiness for Curriculum Change (MORC): Development and Validation of a Questionnaire

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Abstract

Purpose

Because successful change implementation depends on organizational readiness for change, the authors developed and assessed the validity of a questionnaire, based on a theoretical model of organizational readiness for change, designed to measure, specifically, a medical school's organizational readiness for curriculum change (MORC).

Method

In 2012, a panel of medical education experts judged and adapted a preliminary MORC questionnaire through a modified Delphi procedure. The authors administered the resulting questionnaire to medical school faculty involved in curriculum change and tested the psychometric properties using exploratory and confirmatory factor analysis, and generalizability analysis.

Results

The mean relevance score of the Delphi panel (n = 19) reached 4.2 on a five-point Likert-type scale (1 = not relevant and 5 = highly relevant) in the second round, meeting predefined criteria for completing the Delphi procedure. Faculty (n = 991) from 131 medical schools in 56 countries completed MORC. Exploratory factor analysis yielded three underlying factors—motivation, capability, and external pressure—in 12 subscales with 53 items. The scale structure suggested by exploratory factor analysis was confirmed by confirmatory factor analysis. Cronbach alpha ranged from 0.67 to 0.92 for the subscales. Generalizability analysis showed that the MORC results of 5 to 16 faculty members can reliably evaluate a school's organizational readiness for change.

Conclusions

MORC is a valid, reliable questionnaire for measuring organizational readiness for curriculum change in medical schools. It can identify which elements in a change process require special attention so as to increase the chance of successful implementation.

Changes in medical curricula, occurring in response to transformations in health care and society, appear to be an ongoing feature of medical education worldwide.[1] Sadly, despite hard work, successful change has not always been achieved,[2] and although the failure rate is not well documented, it is presumably comparable to the estimated failure rate for business organizations, which is 20% to 70%.[3–5] The literature describes many factors which can impede or facilitate change (e.g., leadership, time, financial resources, ownership, collaboration among departments, and communication).[6–11] The "organizational readiness for change" construct entails many of these factors, and according to the literature, high levels of organizational readiness for change contribute to successful change in health care[3] and business organizations.[10,11] Organizational readiness for change is reflected both in the prevailing beliefs and attitudes among members of an organization regarding the necessity and urgency of change and in the capacity of the organization to successfully implement change.[11] With high levels of readiness, people at all levels within an organization are prepared to invest in change and show perseverance in the face of obstacles and setbacks, thereby increasing the odds in favor of successful implementation.[3] With low levels of readiness, faculty may meet change initiatives with strong resistance.[3,12] Kotter[10] even ascribes half of all failures to low levels of organizational readiness for change.

The field of medical education would benefit from an instrument that can help to identify issues that schools must address to facilitate curriculum innovation.[13,14] For business and health care organizations, numerous instruments are available to measure readiness for change,[3,15] but we know of only two instruments for medical schools.[5,16] Neither of these instruments, however, affords comprehensive measurement of organizational readiness for curriculum change in medical schools. Most instruments are limited to *individual*[16–18] rather than *organizational*[3,19] readiness for change; many have limited evidence of validity and reliability[3,15]; many address only selected aspects[16] or related concepts, such as "openness to change"[5]; and, with some exceptions,[16,20,21] many are of doubtful applicability outside the Western cultural setting where most of them originated. Curriculum change requires, for instance, substantial financial investment, which might be a strong restricting force in countries with lower national wealth. Because no existing instrument seemed suitable, we set out to develop and assess the validity of a comprehensive questionnaire that can be used internationally to measure a medical school's organizational readiness for curriculum change (MORC).

Before describing the conceptual model that guided MORC's development, we explain how we conceptualized organizational readiness for change

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as well as our stance toward the level, timing, and context of the measurement. In the literature, varying definitions of organizational readiness for change point to conceptual ambiguity and differences of opinion as to how and when readiness for change should be measured.[22] Some definitions focus on psychological factors,[23] others on the availability of resources,[18] but most combine psychological (i.e., does the organization want change?) and capability factors (i.e., is the organization able to change?).[24] Important motivation subfactors within an organization include perceived need for change, belief in proposed changes, and commitment to the successful implementation of change. Capability subfactors concern the available capacity for change (expertise, resources, and opportunity) as well as the possibility of deploying that capacity (i.e., the perceived efficacy to implement change). Empirical studies have shown that readiness for change increases with adequate self-efficacy for change, provision of information, perceived organizational support, flexible organizational policies and procedures, and active participation.[25,26] Therefore, for this study, we adopted the following definition of organizational readiness for curriculum change: "Shared motivation and capability among faculty in a medical school to implement curriculum change."

The three major issues to consider when measuring readiness to change are the level, timing, and context of the measurement. *Level* acknowledges that change-readiness is a multilevel construct that can be measured at the level of the organization, departments, teams, or individuals.[22,26] Because curriculum change is a complex process depending on coordinated collective behavior,[24] we focused on the organizational level, as perceived by staff members (i.e., "what we think we can do together").[22] As for *timing*, several authors advocate measuring change-readiness during the initiation phase, before the actual implementation,[3,24] but, like Bouckenooghe and colleagues,[27] we prefer measuring during both the initiation and the implementation phases, which allows for the measuring of alterations in change-readiness after the introduction of adaptations in the change-implementation phase.[13,14] *Context* refers to the question of whether organizational readiness for change should be measured in relation to a specific situation (i.e., the substance and magnitude of the particular change)[20] or as a general characteristic of an organization.[13] We agree with Weiner[22] that the context of organizational readiness for change depends on the type of change that is proposed. For example, a medical school may be quite ready to add skills training to the curriculum, but may resist transitioning to a problem-based learning curriculum.

Despite Holt and colleagues'[24] measurement of factors on the individual level in addition to factors on the organizational level, the conceptual model of organizational readiness for change that they developed is largely consistent with our views. After adapting the individual level factors and incorporating them into the organizational level, we used their model to guide the development of MORC (Figure 1).

To estimate the validity and reliability of the questionnaire, we investigated five research questions (RQs):

1. Does MORC measure organizational readiness for curriculum change in medical schools?
2. Does MORC have a coherent internal factor structure?
3. Is MORC a reliable (reproducible) questionnaire?
4. How many respondents are necessary for a reliable MORC score?
5. Is MORC valid for use in medical schools in different countries?

Method

Overview

In 2012, after designing a preliminary questionnaire based on our conceptual model (see above), we wanted to examine its applicability for medical schools, so we conducted a modified Delphi procedure, comprising rounds of experts indicating their levels of agreement with questionnaire items.[28,29] Per a typical modified Delphi procedure, we did not ask our experts to generate items, but only to evaluate items we previously selected.[29,30] After we finalized the questionnaire, modifying it according to the suggested changes, we administered it to faculty at numerous medical schools in different countries. Finally, we analyzed the obtained dataset to examine the psychometric properties of the questionnaire (Figure 2).

Questionnaire development and modified Delphi procedure

As mentioned, our conceptual model of organizational readiness for change consisted of two main factors—motivation and capacity—and nine subfactors (Figure 1). We included the subscales from existing questionnaires designed for business and health care organizations that best matched our nine subfactors, which resulted in 19 subscales and a total of 111 items. Most of our subscales derived from the questionnaires developed by Helfrich and colleagues[31] (8 subscales) and Lehman and colleagues[13] (4 subscales). After we developed the initial version of the MORC questionnaire, we conducted a pilot study, involving five educational researchers and three higher-educated laypersons who judged the items on face validity, redundancy, and phrasing. On the basis of the results of this pilot study, we reduced the number of items in the questionnaire.

To examine the applicability of the questionnaire for medical schools (RQ 1), we conducted a modified Delphi procedure. We invited experts in curriculum change from the Netherlands (n = 14) and from other countries (n = 6) to serve on a panel and anonymously evaluate the items via a Web-based questionnaire. The participants received a €25 book voucher for rating the relevance to curriculum change of each of the potential questionnaire items on a five-point Likert-type scale (1 = not relevant and 5 = highly relevant). The experts also evaluated redundancies, omissions, and textual shortcomings; many also provided additional qualitative feedback. We either adapted or eliminated (based on the qualitative comments) items with an average rating of < 4 or with an average rating > 4 as judged by fewer than 70% of the panelists. In the absence of an existing standard, we considered the Delphi procedure complete when the overall average rating of MORC exceeded 4 and when over 70% of panelists gave an overall rating of MORC above 4.[32]

Two of us (G.M. and E.D.) discussed a summary of the quantitative and qualitative results as well as the eliminations and adaptations that the main author (M.J.) had suggested until we reached a consensus. This process

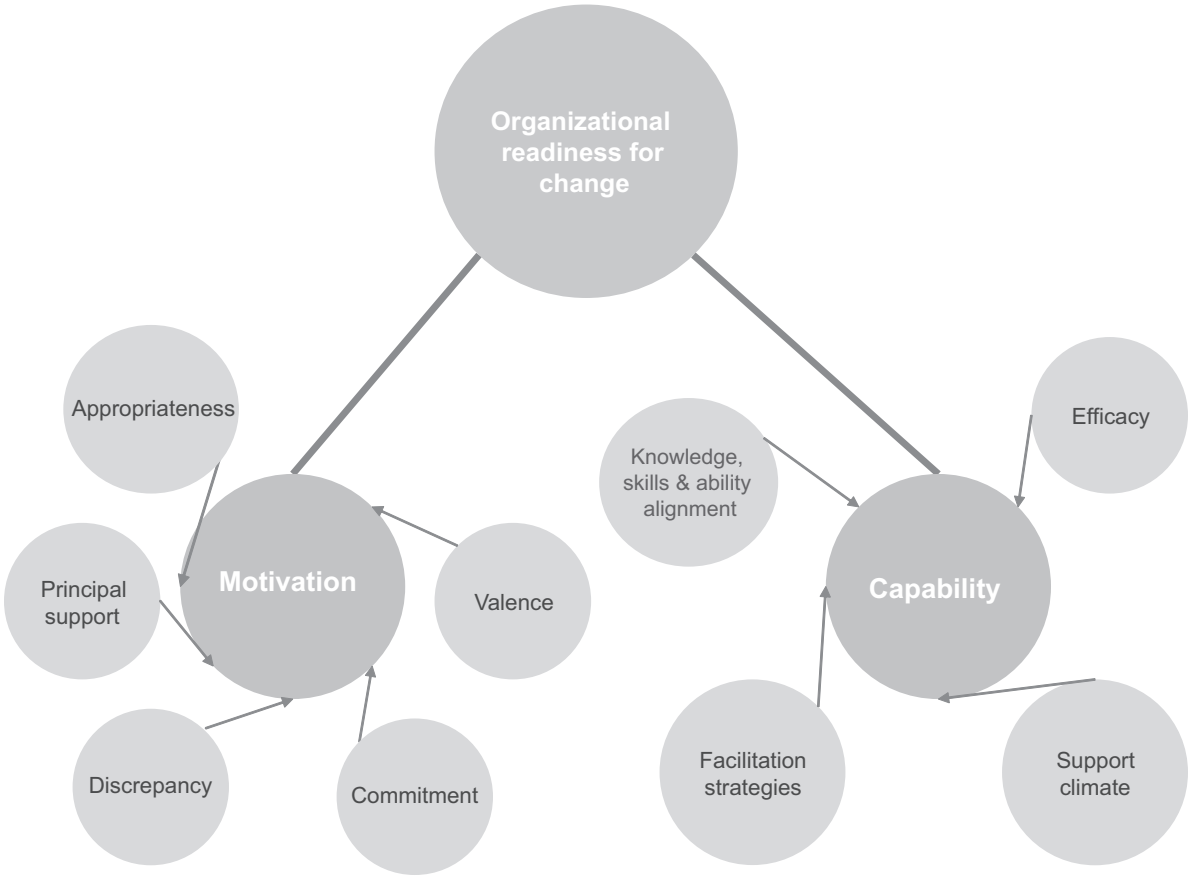

Figure 1 Conceptual model of organizational readiness for change derived from the model of Holt and colleagues.[24] The model comprises the two main factors—motivation and capability—and nine subfactors. Appropriateness: belief that a specific change is correct for the situation being addressed. Principal support: belief that formal and informal leaders are committed to the success of the change. Discrepancy: a difference between the current and a more desirable state. Commitment: shared belief and resolve to pursue courses of action that will lead to successful change. Valence: belief that the change is beneficial. Knowledge, skills, and ability alignment: extent to which the organizational members' knowledge, skills, and abilities align with the change. Facilitation strategies: clear goals and objectives supported by a detailed implementation plan. Support climate: sufficient support of tangible resources (e.g., funding) and intangible environment (e.g., culture). Efficacy: shared belief in capabilities to organize and execute the courses of action required to implement change successfully.

led to the elimination of some items and the relocation of some items to other subscales. We sent the summary of results, together with the request to rate the modified questionnaire, to the panelists. After a similar analysis and discussion, the second round of the Delphi process similarly led to the elimination of some items and to the reconstitution of subscales. Like in the first round, the second round led to fewer subscales and to fewer items (Figure 2).

A pilot study of the resulting questionnaire, involving four international educational researchers and one layperson, led to textual changes only. Next, we translated the final questionnaire from English into Japanese and Spanish (Figure 2) and discussed any differences between the original English version and the retranslated (back into English) versions. Two Japanese and three Spanish faculty members piloted the translated questionnaires and suggested minor language-translation changes only.

Questionnaire administration

We sent e-mails to 1,073 contact persons who were affiliated with Maastricht University through their degree programs or organizational memberships. We asked these contacts at medical schools if their schools were either preparing for or implementing curriculum change; we then asked those who responded yes to participate in the study.

Complete or partial change to the curriculum of the undergraduate or postgraduate medical doctor education program served as the only inclusion criterion. We excluded faculty from newly established medical schools and from schools where curriculum change was complete (i.e., the first students experiencing the new curriculum had graduated). We sent two reminders. We asked the contact persons from schools meeting the inclusion criterion to electronically distribute the MORC questionnaire to at least 20 of their institutional colleagues who were actively involved in medical education and who, preferably, represented a mix of professional backgrounds: basic scientists, clinicians, and members of the curriculum committee. After the contact persons agreed to cooperate, they received two reminders to send the MORC to colleagues in their school.

The MORC asked all participants to rate their agreement with 65 items on a five-point Likert scale (1 = strongly disagree and 5 = strongly agree) or to select "not applicable." In addition we asked general questions about the

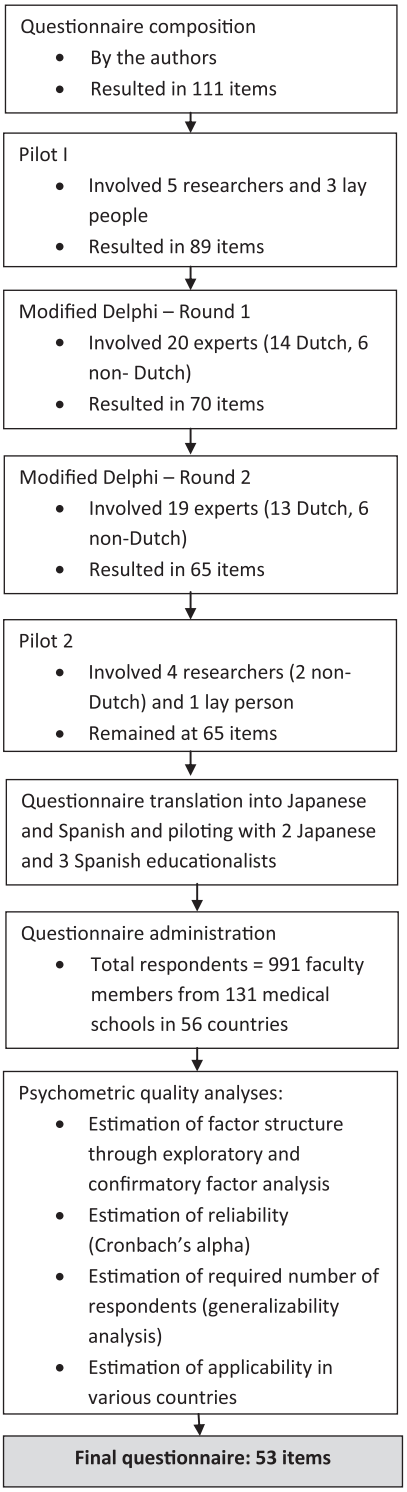

Figure 2 Flowchart of the development of the medical school's organizational readiness for curriculum change (MORC) questionnaire. EFA indicates exploratory factor analysis; CFA, confirmatory factor analysis.

respondent's age, gender, and experience, the size of his or her medical school, and the type of change under way there. Most participants received a Web-based version, but we provided a paper-and-pencil version to participants in countries where contact persons anticipated problems with computer and Internet access. All responses on the MORC were anonymous.

For every participant completing the questionnaire, we donated €5 to the World Wildlife Fund (www.wwf.org). Additionally, on request, each participating medical school received a report with the anonymized results of its school.

Analysis (RQ 2–5)

We conducted exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) to determine the factor structure of MORC (RQ 2). In view of the large number of items, we adopted a cautious strategy and divided the factor analysis into several consecutive steps.[33] First, we randomly divided the dataset into two parts. Using the first half of the data, we conducted EFA for each of the individual subscales which led to the division of some subscales in two separate subscales, and we validated the results of the newly constituted subscales using CFA. Next, we repeated these CFA analyses for the newly constituted subscales using the second half of the dataset in order to determine whether the initial findings could be replicated. After that, we performed a CFA for each subscale on the complete sample.

The subscales identified through EFA and confirmed by CFA permitted the valid computation of sum scores for each subscale; we conducted EFA on these subscale sum scores. We assumed a priori, on the basis of our conceptual model, that we would find the theoretically based division of the subscales in two main factors: motivation and capability. Beside these two factors, we identified a third factor. Finally, we analyzed the individual items of the three main factors in three separate EFAs, which suggested relocation of some items to different subscales. A complementary CFA for each main factor delivered fit indices pertaining to the final structure. We used the following fit indices and criteria: root mean square error of approximation (RMSEA) < 0.08; comparative fit index (CFI) > 0.9; non-normed fit index (NNFI) > 0.9; and standardized root mean square residual (SRMR) < 0.08.[34,35]

To estimate the reliability of the measurements (RQ 3), we calculated Cronbach α for all three main factors and for each subscale.

For the generalizability study (RQ 4), we used variance component analysis to measure the contributions of staff members, medical schools, items, and their interactions to the measurement of MORC.[36] We estimated generalizability coefficients (> 0.7) and standard error of measurement (SEM, < 0.26) for each main factor and subscale to estimate the number of participants needed to glean a reliable score.[30,37] We used the total number of items as a fixed factor and the number of staff members as a random factor.

To estimate the applicability of MORC irrespective of a country's level of national wealth (RQ 5), we divided the participating schools into higher- and lower-income countries, using gross domestic product at purchasing power parity (GDP PPP) of $20,000 per capita as the cutoff point. GDP PPP is the most widely used variable for comparing wealth among different countries, and successful innovations have been shown to increase significantly in countries with a GDP PPP of over $20,000 per capita.[38] The values of GDP PPP per capita were obtained from the Web site Trading Economics.[39] We verified whether the generalizability and reliability coefficients and the fit indices remained stable in the two groups.

We used structural equation modeling software Mplus (version 5.21, Los Angeles, California) for our EFA and CFA, urGENOVA software (version 2.1, Iowa City, Iowa) to analyze generalizability, and SPSS (version 19, Armonk, New York) for all the other analyses.

Ethical approval

After explaining the aim and purpose of the study, the voluntary nature of participation, and the confidentiality of the contributions, we obtained informed consent from all Delphi procedure, pilot, and survey participants. The ethical review board of the Dutch Association for Medical Education approved this study.

Results

Modified Delphi procedure (RQ 1)

Of the 22 experts invited to participate, 20 (91%) participated in the first round. We excluded one participant from Round 2 of the Delphi procedure because of

his or her inexperience with curriculum change; however, the remaining 19 participants (100%) participated in the second round as well. The average item scores increased from 3.8 in the first round to 4.2 in the second round and from 63% of panelists giving an overall rating above 4 in the first round to 84% in the second round; thus, the results of the second round met our preestablished criteria and marked the completion of the Delphi procedure.

The MORC questionnaire

After testing our original 111-item (19-subscale) version of the MORC in the pilot study with education researchers and well-educated laypersons, we reduced the number of items to 89. The first round of the adapted Delphi procedure and the subsequent discussion resulted in the reduction of 19 items (21%) or a 70-item questionnaire (Figure 2). After the second (and last) round of the Delphi procedure and a follow-up discussion, the final MORC questionnaire contained 65 items across 13 subscales.

Questionnaire administration

Of the 1,073 contact persons we initially invited to administer the MORC questionnaire at their schools, 708 (66%) agreed. We do not know how many colleagues each of these contact persons invited to complete the MORC questionnaire.

Table 1 presents the characteristics of the 991 faculty members from 131 medical schools in 56 countries who completed the final questionnaire. Of these 991 participants, 475 (48%) were male, and the average age across all 991 was 47 years (range = 21–84). More background information on the participants is provided in Supplemental Digital Appendix A (http://links.lww.com/ACADMED/A147).

For all analyses, we replaced missing values and ratings of "not applicable" with the corresponding mean item score (Table 2).[40]

EFA and CFA (RQ 2)

Our EFA of the subscales resulted in eight subscales with one underlying factor, four subscales with two underlying factors, and one subscale (*government readiness*) with no underlying factor. The *government readiness* subscale also garnered relatively low scores in the Delphi procedure. Considering, additionally, that many participants answered "Ministry of Health or Education" in response to the item "Other" in the *pressure for change* subscale, we removed the *government readiness* subscale and added the answer option "Ministry of Health or Education" to the *pressure for change* subscale. The 12 remaining subscales had good fit measures in the validation, replication, and the complete sample (RMSEA 0.0–0.11, NNFI = 0.95–1.01, and SRMR = 0.00–0.04; data not shown).

Our EFA of the sum scores of the 12 subscales revealed three main factors:

Table 1

Characteristics of the 991 Respondents to the Medical School's Organizational Readiness for Curriculum Change (MORC) Questionnaire, Along with Characteristics of Their Medical Schools and the Change Processes in Their Schools, 2012

Variable	No. of respondents (% of 991)
Gender	
Male	475 (47.9)
Female	369 (37.2)
Missing	147 (14.8)
Age	
20 – 35 years	124 (12.5)
36 – 50 years	374 (37.7)
51 – 65years	310 (31.3)
65 – 85 years	29 (2.9)
Missing	154 (15.5)
Participation	
Active in the change process	527 (53.2)
Not active in the change process	324 (32.7)
Missing	140 (14.1)
Type of respondents	
Specialists	363 (36.6)
Basic scientists	133 (13.4)
Management and administration	68 (6.9)
Other (including educationalist and general practitioner)	197 (19.9)
Missing	230 (23.2)
Size of medical school	
< 50 students / year	53 (5.3)
51 – 100 students / year	168 (17.0)
101 – 200 students / year	322 (32.5)
> 200 students per year	306 (30.9)
Missing	142 (14.3)
Object of change	
Undergraduate curriculum change	774 (78.1)
Postgraduate curriculum change	62 (6.3)
Missing	155 (15.6)
Type of change	
All students in completely new curriculum	602 (60.7)
Some students in completely new curriculum	195 (19.7)
Exams only	8 (0.80)
Skills only	23 (2.3)
Missing	163 (16.4)
Phase of change	
Preparation	422 (42.6)
Implementation (first two years)	284 (28.7)
Implementation (after the first two years)	284 (28.7)

Table 2

Survey Results, Cronbach Alpha Scores (α), and 2nd Round of an Adapted Delphi Procedure Results of the Medical School's Organizational Readiness for Curriculum Change (MORC) Questionnaire*

MORC factors	MORC items by no. within subscales	No. of respondents	Mean (standard deviation [SD]) score across respondents	α	2nd round adapted Delphi procedure mean (SD)
Motivation	**Pressure for change—Current pressure to change the curriculum comes from…**			0.68	
	1. Bottom up: Students in the program	940	3.24 (1.12)		4.4 (0.6)
	2. Bottom up: Teaching staff (faculty)	954	3.41 (1.00)		4.3 (0.6)
	3. Bottom up: Hospital staff	873	2.88 (1.05)		3.7 (0.9)
	4. Top-down: Educational committee	950	4.15 (0.93)		4.2 (0.7)
	5. Top-down: Dean/Rector	896	4.05 (1.03)		4.5 (0.5)
	6. External: Accreditation authorities	907	3.75 (1.11)		4.3 (0.7)
	7. External: Ministry of Health/Education	New	New		New
	Need for change—There is a need for change			0.72	
	8. There is a significant difference between the current and the desired state of our curriculum	965	3.90 (0.92)		4.2 (0.5)
	9. We need a major change of our curriculum	969	3.82 (0.98)		4.1 (0.7)
	Appropriateness—This change project meets a real need for change			0.79	
	10. This change project is tailored to the needs for change in our school	960	3.88 (0.88)		4.1 (0.8)
	11. There is a high priority for the success of this change project	970	4.05 (0.85)		3.8 (0.9)
	12(R*). The potential benefits of this change are not worth the costs in time and resources required to implement it	960	2.51 (1.22)		4.1 (1.0)
	13. This change serves an important purpose	980	4.21 (0.79)		4.3 (1.1)
	14. This change will put us higher on (inter)national rankings	969	3.96 (0.93)		4.1 (1.0)
	15. This change will improve the knowledge and skills of our graduates	978	4.12 (0.91)		4.7 (0.5)
Capability	**Efficacy—Shared belief in the conjoint capabilities to implement this change successfully**			0.67	
	16. We have the skills in our school that are needed to implement this change	943	3.91 (0.89)		4.4 (0.6)
	17(R*). Considering the trouble we have had in previous change efforts, we will have difficulty implementing this change successfully	897	2.99 (1.07)		3.9 (1.0)
	18. We have been through well-executed changes in the past, and we are confident of our capacity to implement this change	886	3.56 (0.95)		4.1 (1.1)
	The leaders of this change project (such as the head of curriculum change committee) …			0.83	
	19. Are committed to this change.	925	4.01 (0.84)		4.5 (0.7)
	20. Seem to accept full responsibility for this project	916	3.94 (0.93)		4.2 (0.6)
	21. Have the authority to carry out the implementation	917	3.93 (0.88)		4.6 (0.6)
	22. Work well with the implementation team	897	3.87 (0.89)		4.5 (0.5)
	23. Share responsibility for this project	909	3.88 (0.78)		4.4 (0.6)
	The members of the implementation team (e.g. the curriculum change committee) …			0.79	
	24. Have clearly defined roles and responsibilities	893	3.54 (0.94)		4.5 (0.6)
	25. Have release (protected) time for this change project or can combine the tasks with their regular work	898	3.24 (1.02)		4.3 (0.7)
	26. Have staff support and other resources required for the project	901	3.26 (1.03)		4.7 (0.6)
	Staff innovativeness—The majority of staff members involved with teaching…			0.69	
	27. Have a sense of personal responsibility for improving education	937	3.82 (0.89)		4.3 (0.7)
	28. Are willing to innovate and/or experiment to improve teaching	928	3.68 (0.87)		4.2 (0.8)

(*Table continues*)

Table 2
(*Continued*)

MORC factors	MORC items by no. within subscales	No. of respondents	Mean (standard deviation [SD]) score across respondents	α	2nd round adapted Delphi procedure mean (SD)
	Communication			0.92	
	29. There is good communication between project leaders and staff members about the school's policy towards the change	923	3.42 (0.99)		4.5 (0.8)
	30. The information provided about the change is clear	926	3.39 (1.03)		4.5 (0.5)
	31. In this school we are sufficiently informed about the progress of the change.	924	3.28 (1.02)		4.4 (0.8)
	32. Departments are sufficiently consulted about the change	913	3.28 (1.04)		4.2 (1.0)
	33. Staff members are sufficiently informed about the reasons for the change	924	3.44 (1.03)		4.3 (0.9)
	34. Our medical school has a clear vision regarding this change project	931	3.73 (0.95)		4.5 (0.8)
	35. Our vision of this change project is widely communicated and understood throughout our medical school	931	3.32 (1.00)		4.5 (0.8)
	Project resources—The following resources are available to make this change project work:			0.87	
	36. Financial resources	895	3.18 (1.11)		4.7 (0.6)
	37. Staff development (such as courses/workshops regarding the change project)	921	3.43 (1.07)		4.6 (0.6)
	38. Facilities (such as teaching rooms, books, computers etc)	922	3.44 (1.10)		4.5 (0.6)
	39. Sufficient staff	922	2.99 (1.13)		4.7 (0.6)
	40. Incentives for staff that support the change project (either financial, material, or promotional)	900	2.71 (1.12)		4.4 (0.6)
	41. Student awareness/needs	919	3.49 (0.98)		4.1 (0.7)
	42. Evaluation protocol	895	3.34 (1.05)		4.3 (0.9)
	The implementation plan for this change project …			0.87	
	43. Identifies specific roles and responsibilities for staff	895	3.54 (0.92)		4.3 (0.7)
	44. Clearly describes tasks and long term timelines	890	3.46 (0.94)		4.3 (0.7)
	45. Includes appropriate staff/student training	894	3.39 (0.98)		4.4 (0.6)
	46. Acknowledges staff input and opinions	894	3.54 (0.95)		4.4 (0.8)
External pressure	**Barriers to innovation—The majority of staff members involved with teaching …**			0.69	
	47. Feel that there is ineffective cooperation between departments concerning educational issues	914	3.41 (0.98)		3.9 (0.7)
	48. Feel that many departments are afraid to lose power in controlling the teaching of their discipline	916	3.44 (1.06)		4.1 (1.1)
	49. Feel that this change will increase their workload	917	3.75 (0.94)		4.3 (0.8)
	50. Feel restricted by strong hierarchy to express their views	913	2.93 (1.08)		3.9 (0.9)
	51. Are afraid to lose income when this change is implemented	892	2.45 (1.02)		3.8 (1.0)
	Extrinsic motivation to change			0.69	
	52. We have to change because our management wants us to change	961	3.15 (1.10)		3.6 (1.0)
	53. In our school we feel pressure to go along with this change	961	3.30 (1.06)		3.9 (0.7)

* R = reversed phrased

motivation, *capability* (which, as mentioned, we predicted a priori), and a third, unexpected factor which we labeled *external pressure*. We accordingly divided the questionnaire into three parts and analyzed each of these separately using EFA. We relocated items that were conceptually valid to alternate subscales, as the EFA results suggested. For instance, all 5 items from the subscale *staff involvement* and 2 items from *vision* showed one underlying factor in EFA, and all 7 of these items addressed aspects of communication, so we created a new subscale named *communication*. We found that the third factor *external pressure* consisted of two subscales, which we labeled *extrinsic motivation to change* and *external barriers to innovation* (Table 2). After these changes, the final MORC questionnaire consisted of three main factors, 12 subscales, and 53 items (Figure 2; Tables 2 and 3; contact

Table 3

Main Scales, Subscales, Number of Items per Subscale, and the Original Subscales for the Medical School's Organizational Readiness for Curriculum Change (MORC) Questionnaire

Main scales*	Subscales	No. of items	Original subscale from which it was adapted
M1. Pressure for change	M1. Pressure for change	7	Pressure for change[13]
M2. Need for change	M2. Need for change	2	Discrepancy[12]
M3. Appropriateness	M3. Appropriateness	6	Valence[12] and commitment to change[41]
C1. Efficacy	C1. Efficacy	3	Efficacy[12]
C2. Support climate	C2a. Leaders of the change project	5	a. Project champion roles[31] and management support[12]
	C2b. Implementation team	3	b. Implementation team roles[31]
	C2c. Staff innovativeness	2	c. Staff culture[31] and staff cohesiveness[13]
	C2d. Communication	7	d. Involvement[27] and commitment[45]
	C2e. Project resources	7	e. Project resources[31]
C3. Facilitation strategies	C3. Implementation plan	4	Implementation plan[31]
E1. Barriers to innovation	E1. Barriers to innovation	5	Staff culture[31] and staff cohesiveness[13]
E2. Extrinsic motivation to change	E2. Extrinsic motivation to change	2	Commitment to change[41]
Total		53	

*M1-3: motivation factors; C1-3: capability factors; E1-2: external pressure factors.

authors for detailed information on the reduction of 65 items to 53).

The three CFA analyses showed good fit indices for the three main factors (CFI = 0.91–0.95, NNFI = 0.89–0.93, RMSEA = 0.06–0.07, and SRMR = 0.04–0.05; Table 4).

Reliability analysis (RQ 3)

Cronbach alpha varied from 0.67 to 0.95 for the main factors (Table 4) and from 0.67 to 0.92 for the final subscales (Table 2).

Generalizability analysis (RQ 4 and 5)

The school-related variance in the overall scores of MORC was 4% as determined by generalizability analysis. As the items were regarded as fixed, the addition of item-related variance resulted in 5.3% of systemic variance associated with schools. The variance associated with respondents nested within medical schools for the overall MORC score was 16% (Table 5). At least 16 faculty members had to complete MORC to obtain a sufficient generalizability coefficient (> 0.7) for all three main factors. For a sufficient SEM (< 0.26), at least five faculty members had to complete the questionnaire.

In the two groups with different levels of national wealth, the reliability coefficients (Table 4) and fit indices remained stable (NNFI = 0.88–0.92, RMSEA = 0.061–0.076, SRMR = 0.061–0.076), indicating the international applicability of MORC.

Discussion

The aim of this study was to develop and assess the MORC questionnaire. Most studies on questionnaires measuring organizational change-readiness have reported limited evidence of validity and reliability.[3,15] Our approach—comprising a conceptual model, piloting, a modified Delphi procedure, EFA, CFA, generalizability analysis, and a large international sample of participants—yielded a solid basis for validation. The results suggest that MORC serves as a valid questionnaire, is applicable in different cultures (despite the fact that the conceptual model is based on a Western theory), and yields reliable results with as few as 5 to 16 respondents.

Contrary to our assumption that MORC would have two underlying main factors (i.e., *motivation* and *capability*), the analysis revealed a third factor. We labeled this third factor *external pressure* because

Table 4

Goodness of Fit Measures from Confirmatory Factor Analysis of the Whole Group and Cronbach's alpha (α) of the Whole Group and for Two Subgroups for the Three Main Factors for the Medical School's Organizational Readiness for Curriculum Change (MORC) Questionnaire*

Main factor	CFI	NNFI	RMSEA	SRMR	Cronbach's α for whole group	Cronbach's α for GDP high group	Cronbach's α for GDP low group
Motivation	0.906	**0.894**	0.063	0.047	0.81	0.77	0.85
Capability	0.945	0.925	0.061	0.037	0.95	0.95	0.95
External pressure	0.945	0.912	0.069	0.039	**0.67**	**0.69**	**0.66**

* CFI = the comparative fit index (should be > 0.9); NNFI = the non-normed fit index (should be > 0.9); RMSEA = the root mean square error of approximation (should be < 0.08); and SRMR = standardized root mean square residual (should be < 0.05). Cronbach's alpha should be > 0.7. GDP PPP = gross domestic product purchasing power parity. GDP high group [GDP > $20,000] and GDP low group [GDP < $20,000]; Bold means beyond range.

Table 5

Variance Component Estimates and Number of Raters Required for Reliable Score for the Medical School's Organizational Readiness for Curriculum Change (MORC) Questionnaire*

Factor / Subscale No. and Name (with factor)	S	R:S	I	SI	RI:S,e	R-G	R-SEM
Factor							
Motivation (M)	0.03	0.18	0.15	0.09	0.62	15	4
Capability (C)	0.07	0.27	0.09	0.05	0.50	10	5
External pressure (E)	0.03	0.19	0.18	0.07	0.72	16	5
Subscale							
1. Pressure for change (M)	0.01	0.24	0.24	0.12	0.64	26	5
2. Need for change (M)	0.07	0.40	0.00	0.02	0.38	16	9
3. Appropriateness (M)	0.06	0.27	0.06	0.07	0.46	12	5
4. Efficacy (C)	0.09	0.26	0.20	0.05	0.45	9	6
5. The leaders of this change project (C)	0.06	0.27	0.00	0.03	0.32	11	5
6. The members of the implementation team (C)	0.06	0.44	0.03	0.03	0.36	19	8
7. Staff innovativeness (C)	0.05	0.37	0.01	0.01	0.28	20	8
8. Communication (C)	0.10	0.51	0.02	0.02	0.33	13	8
9. Project resources (C)	0.11	0.44	0.08	0.07	0.46	10	8
10. The implementation plan (C)	0.07	0.44	0.00	0.02	0.28	17	8
11. External innovativeness inhibition (E)	0.04	0.24	0.26	0.05	0.61	16	6
12. Extrinsic motivation to change (E)	0.09	0.50	0.01	0.02	0.52	18	11
Total	0.04	0.16	0.20	0.08	0.63	11	3

*S = schools; R:S = raters within schools; I = items; SI = school by item interaction; and RI:S,e = residual; R-G = Number of raters required for generalizability coefficient > 0.7; and R-SEM = Number of raters required for Standard Error of Measurement (SEM) < 0.26.

the items originated from capability subscales addressing external factors inhibiting change and motivational subscales addressing extrinsic motivation. This third main factor aligns with previous research, distinguishing between intrinsic and extrinsic motivation in relation to organizational change[41]; Herscovitch and Meyer[41] showed that organizational members who are internally motivated expressed higher levels of support for change projects. Because organizational readiness is not a homogenous construct, we suggest using caution in comparing overall MORC scores within individual and across different medical schools.

Strengths and limitations

One potential strength of MORC lies in its ability to compare subscale scores; for instance, sequential MORC administrations within one school would allow leaders to measure the effects of an intervention aimed at facilitating curriculum change.[13,14]

A limitation of this study is the relatively large number of missing answers in the questionnaire: up to 8.8% for MORC and 23.2% for the general, primarily demographic questions (Table 1). Possibly, the respondents grew tired answering the 65 MORC items and skipped the general questions, which were positioned at the end.

Another limitation is the inability to provide a response rate of the invited participants. We are able to provide a response rate for the invited contact persons of Maastricht University, but because these contact persons were responsible for inviting faculty members in their medical schools, we have no insight into how many total people were invited to participate.

A further potential limitation is socially acceptable answers.[42] It may not be coincidental that the subscale on the capability of management did not show a coherent factor structure (data not shown). Despite the anonymity of the survey, participants may have been reluctant to judge their superiors.

Future research

Leaders and administrators at medical schools in different countries can use the validated MORC to shed light on issues related to curriculum change at their institutions; for instance, the MORC could help them determine whether, as has been argued,[43] bottom-up pressure for change is in fact more effective than top-down pressure (subscale 1) or whether the most effective type of pressure varies with the setting and culture of medical schools.[11,16,18,22,23,26,44,45] Using the MORC may help show that authoritative leadership and top-down pressure may be very effective when they are widely accepted within the organization and when members feel sufficiently consulted and informed (subscale 8).[46] Although we developed MORC specifically for medical schools preparing to or actually experiencing change in their curriculum, with minor adaptations the questionnaire could also be used for other change processes (e.g., transitioning to a new governance structure) in medical schools and/or other settings (e.g., schools for allied health professionals, hospitals undergoing organizational changes).

Although MORC focuses on faculty to the neglect of students, students obviously have an important contribution to make to curriculum change. In future research it would be interesting to combine MORC results with students' opinions (e.g., those obtained using the Dundee Ready Educational Environment Measure questionnaire[47]).

The medical education experts who participated in our modified Delphi procedure rated the relevance of aspects of curriculum change, but they did not differentiate between the importance of items during different phases of curriculum change.[8] We included participants from schools in the preparation or implementation phase of curriculum change, and in future research it would be interesting to administer MORC in medical schools in the institutionalization phase to determine, in retrospect, whether determinants of successful change vary between the phases of curriculum change.

Conclusions

MORC is a valid and reliable questionnaire for measuring organizational readiness for curriculum change in medical schools. It can identify which elements in a change process require special attention

so as to increase the chance of successful implementation.

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