

Medical educators' beliefs about teaching, learning, and knowledge: development of a new framework

Marleen Ottenhoff- de Jonge (✉ m.w.ottenhoff@lumc.nl)

Leiden University Medical Center

Iris van der Hoeven

Leiden University Medical Center

Neil Gesundheit

Stanford University School of Medicine

Roeland van der Rijst

Leiden University Graduate School of Teaching

Anneke Kramer

Leiden University Medical Center

Research Article

Keywords: teacher beliefs, beliefs, conceptions of learning and teaching, educational beliefs, educational framework, faculty development, framework validation, orientations to learning and teaching

Posted Date: January 5th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-134163/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

Version of Record: A version of this preprint was published on March 21st, 2021. See the published version at <https://doi.org/10.1186/s12909-021-02587-x>.

Abstract

Background

The educational beliefs of medical educators influence their teaching practices. Insight into these beliefs is important for medical schools to improve the quality of education they provide students and to guide faculty development.

Several studies in the field of higher education have explored the educational beliefs of educators, resulting in classifications that provide a structural basis for diverse beliefs. However, few classification studies have been conducted in the field of medical education. We propose a framework that describes faculty beliefs about teaching, learning, and knowledge which is specifically adapted to the medical education context. The proposed framework describes a matrix in which educational beliefs are organised two dimensionally into belief orientations and belief dimensions. The belief orientations range from teaching-centred to learning-centred; the belief dimensions represent qualitatively distinct aspects of beliefs, such as 'desired learning outcomes' and 'students' motivation'.

Methods

We conducted in-depth semi-structured interviews with 26 faculty members, all of whom were deeply involved in teaching, from two prominent medical schools. We used the original framework of Samuelowicz and Bain as a starting point for context-specific adaptation. The qualitative analysis consisted of relating relevant interview fragments to the Samuelowicz and Bain framework, while remaining open to potentially new beliefs identified during the interviews. A range of strategies were employed to ensure the quality of the results.

Results

We identified a new belief dimension and adapted or refined other dimensions to apply in the context of medical education. The belief orientations that have counterparts in the original Samuelowicz and Bain framework are described more precisely in the new framework. The new framework sharpens the boundary between teaching-centred and learning-centred belief orientations.

Conclusions

Our findings confirm the relevance of the structure of the original Samuelowicz and Bain beliefs framework. However, multiple adaptations and refinements were necessary to align the framework to the context of medical education. The refined belief dimensions and belief orientations enable a comprehensive description of the educational beliefs of medical educators. With these adaptations, the new framework provides a contemporary instrument to improve medical education and potentially assist in faculty development of medical educators.

Background

The beliefs medical educators hold about teaching, learning, and knowledge determine to a large extent their teaching approaches [1–5]. Because personal educational beliefs drive educators' behaviour while teaching, these beliefs should be considered a starting point from which to improve the quality of education [6, 7]. Supporting this view, Kember and Kwan stated that fundamental changes to the quality of education rely on changes in educational beliefs [8]. Thus, obtaining more insight into those beliefs is important for the quality of education and may help us to understand why education reform can be cumbersome and faculty development often falls short of changing pedagogical practices [9].

Within the context of higher education a number of studies have explored the educational beliefs of educators and have proposed classification rubrics [2, 6, 8, 10–15]. Such classifications are useful to distinguish between beliefs in a structured way and provide insight into relevant aspects of educational beliefs. However, these classification studies have not been conducted in the field of medical education. Our study addresses a framework that can be used in student-centred curricula, since currently most medical curricula have adopted student-centred approaches. We propose a beliefs framework to improve suitability in the context of contemporary medical education.

Belief orientations

Prior classification studies [2, 6, 8, 10, 11, 13–15] have classified beliefs as global orientations in a continuum, ranging from teaching-centred to learning-centred. While teaching-centred belief orientations focus on the transmission of defined content or knowledge in alignment with a traditional teacher-centred curriculum, learning-centred belief orientations focus on students' conceptual understanding and development. Light and Calkins [15] describe a classification differentiating three belief orientations: teaching-centred, intermediate, and learning-centred. However, they do not base their classification on a fixed set of 'dimensions', by which is meant qualitatively different aspects of beliefs. Another classification proposed by Postareff and Lindblom-Ylänne [11] distinguishes ten different dimensions of beliefs about teaching, learning, and knowledge, structured into four groups. However, this study only differentiates the two belief orientations: teaching-centred and learning-centred.

Framework of educational beliefs

The primary reason that we chose the framework of Samuelowicz and Bain [14] as the starting point for our study was that in higher education literature their framework is the most extensive, with the broadest scope and content in both belief dimensions and belief orientations. Their framework was originally developed in contexts outside of medical education. It distinguishes seven belief orientations, ranging from teaching-centred to learning-centred. The Samuelowicz and Bain framework (see Additional file 1) comprises a matrix ordered according to these belief orientations and belief dimensions. A belief orientation represents a global, composite set of beliefs. In the framework the belief orientations are organised as columns (horizontally) ranging from teaching-centred to learning-centred; qualitatively different belief dimensions appear as rows (vertical entries) in the matrix and create distinctions between the

belief orientations. Examples of belief dimensions are 'desired learning outcomes' or 'students' motivation'. Within each dimension a range of beliefs can be distinguished. For example, the beliefs listed within the dimension 'desired learning outcomes' are 'recall of atomised information', 'reproductive understanding', and 'change in ways of thinking', respectively, ordered on a continuum from teaching-centred to learning-centred. Thus each belief orientation can be further characterised by the belief dimensions. In our opinion, the Samuelowicz and Bain framework's extensiveness does justice to the complexity and diversity of educators' beliefs about teaching, learning, and knowledge.

A second reason why we chose this framework as a starting point is how the authors define 'educational beliefs'. According to their definition, beliefs are 'typical or characteristic ways' in which teaching, learning, and knowledge are viewed; they are closely related with practice and contain both cognitive and affective components. These beliefs can only be considered in a holistic way [16]. Thus, the framework describes educators' deeply rooted, characteristic ways of understanding teaching, and the close relationship between beliefs and practice increases the framework's usefulness for faculty development interventions.

Finally, the framework uniquely includes a belief dimension related to students' professional development, which is particularly significant in the context of medical education and has received much attention in recent medical education literature [17–19].

Research aim and question

The original Samuelowicz and Bain framework was developed across a range of higher education disciplines. Therefore, we aimed to adapt this framework to medical education contexts, in order to address the following research question:

What is the content and structure of the beliefs of educators about teaching, learning, and knowledge in medical education?

Methods

In order to address our research question we conducted a qualitative study using in-depth semi-structured interviews. We interviewed 26 medical educators from two medical schools, all working on preclinical curriculum. Our aim was to identify the participants' characteristic educational beliefs as exemplified by their day-to-day teaching practices. We used a variety of strategies to enhance the quality of our results [20].

This study is part of a larger research project that explores the longitudinal development of the beliefs of medical educators about teaching, learning, knowledge, and teacher qualities. In this study we report outcomes of the baseline study conducted in 2008–2010 with regard to beliefs about teaching, learning, and knowledge.

Participants and setting

We opted for a wide variety of participants in our sampling. For this reason, two prominent medical schools from different continents were chosen. We invited thirteen faculty members from each school, all physicians, to participate. Selection of participants took place on the recommendation of a senior educator and sub-dean from the respective medical schools. The selection of participants was based on the educators' informal educational leadership, student evaluations of teaching performance, teaching awards won by faculty, and faculty members' active educational involvement. These selection criteria were chosen because we anticipated that the faculty participants would be most information-rich and their experiences illuminating (*critical case* sampling; [21]). With the exception of one educator, all participants had at least ten years of teaching experience, with an average of 21 years. Only one out of the 26 originally selected medical educators was not able to participate and was replaced by another medical educator who met the criteria.

The two medical schools involved were Stanford University School of Medicine (SUSM), California, USA, and Leiden University Medical Centre (LUMC), Leiden, The Netherlands. Both schools can be classified as research-intensive medical schools and had had their curricula redesigned in the decade prior to the interviews, adopting a more student-centred approach. Student-centred curricula have gained popularity worldwide in recent decades and are most common today in medical education. At SUSM a faculty development programme had been implemented for over a decade with topics related to a learning-centred teaching approach. Most SUSM participants had participated in this programme. At the time of the interviews, no structured faculty development programme had yet been implemented at the LUMC.

Procedure

All interviews were conducted by the first author to exclude interpersonal variations during the interviews. We used the interview guide of Samuelowicz and Bain with open-ended questions concerning teaching, learning, and knowledge [14] as a basis for the interview (see interview guide in Additional file 2). Where relevant, we explicitly asked participants to reflect on their small group teaching (classroom instruction within a structured module). Because some literature concludes that educational beliefs can be influenced by class size [22], we wanted to avoid participants answering the questions with exclusively large group lectures in mind. We expected the small group setting to give the most insightful information about participants' educational beliefs. To make sure that our findings would also be generalizable to other teaching formats, we added two questions: first, if the participants believed the teaching format (small group versus large group versus one-on-one teaching) influenced their teaching; second, if they believed the teaching format influenced students' learning. In this way we aimed to gain insight into the beliefs applicable to these educational settings. We also requested that participants focus on their preclinical teaching to rule out differences in course level as an influencing contextual factor, since beliefs may vary according to the level of teaching [13, 22]. Because we aimed to develop a comprehensive holistic image of the beliefs of the faculty participants, we asked them to illustrate their perspectives with examples from their teaching sessions, and focused further exploration on the examples that were provided. The interviews of one-hour duration on average were audio-taped and transcribed verbatim. Preceding the interview, the participant completed a brief survey to collect demographic data. We tested both the interview protocol and the survey questions in a pilot study with three participants who did not contribute to the main study. One of these participants was bilingual. Using their comments we improved the interview questions and were able to address potential language issues.

Ethics approval and consent to participate

This study was granted an ethics waiver by the Medical School Ethics Committee of the LUMC (reference C15.033/SH/sh). According to the same committee, formal written informed consent was not required. Similarly, the study was deemed as 'not involving human subjects research' by the Stanford University Human Subjects Committee and was exempt from human subjects oversight. The first author invited all the participants by email or telephone, emphasising that participation was voluntary and anonymous. All participants gave oral consent.

Analysis

For the analysis of the data, we used the original framework as a starting point for context-specific adaptation. The analysis consisted of relating relevant interview fragments to the original framework, while we explicitly remained open to ways to modify the framework based on additional beliefs, belief dimensions, or belief orientations identified.

First, each transcript was read and re-read to get an overall sense of the way in which teaching, learning, or knowledge was conceptualised. Then 'areas of meaning', text fragments that related to participants' educational beliefs, were identified. These text fragments were labelled according to the belief dimensions and beliefs of the original framework [14]. Text fragments which did not match an existing belief dimension or belief were given a preliminary code based on the content of the interview fragment. Two team members (IH and MO) analysed each interview independently to enhance *credibility* [20], using Atlas-ti qualitative data analysis software. After the initial coding, the two team members discussed the results. Demarcation rules between the dimensions as well as between the constituent beliefs within each dimension were fine-tuned during the iterative analysis process to enable consistent coding. Parallel to this process we discussed potential new dimensions with their constituent beliefs, grouping and re-grouping the preliminary coded text fragments. Repeated re-coding occurred, and the iterative process continued until all the dimensions and their constituent beliefs stabilised ('code' saturation, a technique to improve the *dependability* of the research; [23]). This happened after eighteen interviews. We frequently negotiated our data together with a third team member (RR) (*investigator triangulation*), looking for evidence and counter-evidence within the data, to reach consensus on all the identified text fragments and to reach agreement as to which dimension they belonged to as well as their constituent belief.

We determined a preliminary belief orientation of the participant holistically, i.e. based on the whole transcript, including all the labelled text fragments. To further confirm data *credibility*, the five interviews which IH and MO considered most difficult to reach consensus on were analysed independently by RR and the results were negotiated within the research team. The remaining interviews were analysed by both IH and MO, who reached negotiated consensus. During this procedure some minor adaptations were made to belief descriptions. Finally, we re-read all the transcripts again to further ensure data *dependability*, and to confirm 'meaning' saturation [23], that is, we checked if we had harvested all the new insights from the data. At the same time, we checked the consistency of the overall belief orientation for each participant, using the final version of the new framework. The process and findings were discussed with the other members of the research team to enhance *confirmability*. Consensus was reached on the adaptation and refinement of the framework.

Quality strategies

Diverse strategies were used to further confirm the quality of our results. First, we determined an inter-rater agreement of the participants' belief orientations with the help of an independent research assistant. This assistant was trained in the analysis procedure, using the new framework and codebook, to enable determination of inter-rater agreement (*confirmability by external rater*). Because the final belief orientations were determined holistically, we decided that we would compare the outcome at the level of the overall belief orientation rather than at the level of text fragments. The inter-rater agreement was determined on eighteen interviews through calculation of Cohen's Kappa.

Second, we compared the data from different groups of participants which we expected to differ in belief orientations (*transferability*). For this reason, within each medical school we had selected participants who taught basic science and clinical subjects, respectively, and participants with roles at the highest educational administrative level with teaching experience. Three sets of groups were compared. The first set included all SUSM participants *versus* all LUMC participants. We expected the SUSM participants to show a more learning-centred belief orientation as compared to the LUMC participants, since some studies show that faculty development programmes can help educators to adopt a more learning-centred belief orientation [24–27]. At SUSM, unlike at the LUMC, most participants had participated in faculty development programmes. The second set included all ten educators teaching basic science topics (such as immunology or pathology), *versus* all ten educators teaching clinical science topics (for example, internal medicine or clinical reasoning). We expected those teaching clinical topics to show a more learning-centred belief orientation, as described in other studies [28–31]. We used a Chi-square test (IBM SPSS 20) for trend to compare these ordinal outcome data. The third set included per medical school the three administrators in influential educational leadership positions *versus* all of the other (ten) educators, which we compared qualitatively. From the literature we know that educators' educational beliefs are influenced by academic leadership [25, 33–37]. If the new framework could distinguish between the beliefs of educators within these three different sets, this would support the sensitivity of the new framework to identify differences.

Third, we aimed to ensure the quality of the findings by the provision of illustrative interview fragments in the results section, including two narratives of participants with contrasting educational belief orientations (*thick description*, adding to the *transferability* of the findings). We chose one educator holding the most teaching-centred belief orientation (Orientation I), and one holding the most learning-centred belief orientation (Orientation VI).

Results

The new framework

Although many beliefs described in the original Samuelowicz and Bain framework were also applicable in a medical education context, our data gave rise to new insights and allowed for refinements. The necessary adaptations in belief orientations and dimensions, including their constituent beliefs, will be described below.

The new framework (Table 1) is comprised of six belief orientations, set out as columns, and nine belief dimensions set out as rows, representing qualitatively distinct aspects of beliefs about teaching, learning, and knowledge. Within each dimension three or four different beliefs can be distinguished. To facilitate the descriptions, beliefs have been categorised as A (teaching-centred), A/b (teaching-centred but with learning-centred aspects), B/a (learning-centred but with teaching-centred aspects), and B (learning-centred). Each of the orientations is thus defined as a unique pattern of beliefs within nine belief dimensions.

Table 1
New framework of belief orientations defined by their constituent belief dimensions and beliefs

Dimensions	Teaching- centred orientations						Learning- centred orientations					
	I. Imparting information		II. Transmitting structured knowledge		III. Providing and facilitating understanding		IV. Helping student develop expertise		V. Sharing the responsibility for developing expertise		VI. Negotiating meaning	
1 Desired learning outcomes	Recall of atomised information	A	Reproductive understanding	A/b	Reproductive understanding	A/b	Change in ways of thinking	B	Change in ways of thinking	B	Change in ways of thinking	
2 Expected use of knowledge	Within subject	A	Within subject for future use	A/b	Within subject for future use	A/b	Interpretation of reality	B	Interpretation of reality	B	Interpretation of reality	
3 Responsibility for transforming knowledge	Teacher	A	Teacher	A	Teacher shows how knowledge can be used	A/b	Teacher helps student	B/a	Students & teacher	B	Students & teacher	
4 Nature of knowledge	Externally constructed, focus on information/ structured knowledge	A	Externally constructed, focus on information/ structured knowledge	A	Externally constructed, teacher shows how knowledge can be used in reality	A/b	Personalised, focus on learning from reality	B	Personalised, focus on learning from reality	B	Personalised, focus on learning from reality	
5 Students' existing conceptions	Not taken into account	A	Not taken into account	A	Not taken into account	A	Used as basis for developing expertise	B/a	Used as basis for developing expertise	B/a	Used to negotiate meaning	
6 Teacher-student interaction	Not stressed	A	Reciprocal to maintain students' attention	A/b	Reciprocal to clarify understanding	B/a	Reciprocal to clarify understanding	B/a	Reciprocal to negotiate meaning	B	Reciprocal to negotiate meaning	
7 Creation of a conducive learning environment	Not stressed	A	Not stressed	A	Stressed, to make the students feel at ease	A/b	Stressed, to help individual student	B/a	Stressed, to allow each individual student to learn	B	Stressed, to allow each individual student to learn	
8 Professional development	Not stressed	A	Not stressed	A	Certain competencies stressed	A/b	Stressed, teacher helps student in their professional development	B/a	Stressed, teacher fosters professional development of student	B	Stressed, teacher fosters professional development of student	
9 Students' motivation	Teacher tries to transmit motivation to students.	A	Teacher tries to transmit motivation to students	A	Teacher is aware of students' intrinsic motivation	A/b	Teacher is aware of individual differences in students' motivation	B/a	Teacher is aware of individual differences in students' motivation	B/a	Teacher fosters intrinsic motivation of the individual student to enhance the learning	

Additional file 1: Samuelowicz & Bain Framework [14]

<Please insert Table 1 about here>

Belief orientations in the new framework

The six distinct belief orientations have been ordered from left to right according to the degree of learning-centredness and have been numbered I to VI. The original framework's seventh, most learning-centred orientation, labelled 'Encouraging knowledge creation' was not observed in our data. Central to this orientation is the belief that students should be in control of the learning content. We changed the label of Orientation V from 'Preventing misunderstandings' to 'Sharing the responsibility for developing expertise'. This better summarised the pattern of beliefs, due to a change in belief related to the dimension 'Students existing conceptions' (Dimension 5).

As in the original framework, the medical educators' focus in Orientations I to III was on the content and its transmission; hence, we conclude that these orientations are teaching-centred. In Orientations IV to VI the focus of the educators was on student learning and development, so we conclude these represent learning-centred belief orientations. The two belief orientations on either side of the teaching-centred *versus* learning-centred 'divide,' Orientations III and IV, share just one belief. In the original framework these two orientations shared two common beliefs. All other adjacent belief orientations share three to seven beliefs. In the original framework the other adjacent belief orientations shared six to eight beliefs.

Belief dimensions and their constituent beliefs in the new framework

One of the original dimensions, 'Control of content' disappeared in the new framework because none of the participants expressed that the control of content was to be determined by the student. However, we distilled a new dimension from our data, 'Creation of a conducive learning environment' (Dimension 7). We discovered that many of the participants believed this to be an important responsibility of the educator to enhance the learning of the student. Apart from two dimensions (Dimension 1 and 2), all dimensions had to be adjusted or refined. Within the dimension 'Responsibility for transforming knowledge' (Dimension 3), we made minor changes to the description of beliefs to better fit the content of our findings. The dimension 'Students' existing conceptions' (Dimension 5) needed an adjustment: whereas in the original framework under belief orientation IV students' existing conceptions were not taken into account, we found that our participants holding an Orientation IV believed these conceptions should be used as a basis for developing expertise.

Interviewer: *'What do the students bring to the learning process?'*

Participant: *'Knowledge, and experience. (...) Indeed, you should – and maybe that's the most difficult or challenging – make use of where the student is at this moment and take the next step further to learn new things.'* (Dimension 5 B/a; L01)

We labelled this fragment a learning-centred belief with teaching-centred aspects (D 5B/a), because this participant, unlike participants with teaching-centred belief orientations (I to III), realises that students are not 'empty vessels' but come to a teaching session with their own knowledge and experience. The educator sees it as their responsibility to use and build on these and, together with the students, to further develop knowledge constructs.

We uncovered the same belief (D5 B/a), using students' existing conceptions as a basis for developing expertise, for the participants holding an Orientation V, which was also incongruent with the original framework. In the original framework, educators with an Orientation V believed that they should prevent common misunderstandings by pointing them out to students and explaining why the established view is more suitable. Thus, in comparison to the original framework, the emphasis in our findings is less on correcting misconceptions and more on activating (pre-)conceptions to develop expertise.

In the most learning-centred belief within this dimension (labelled D5B), participants emphasised that they themselves also learn from the conceptions that students present. To these educators, learning encompasses a two-way exchange of conceptions to negotiate meaning. We changed the label accordingly in our new framework.

The dimension 'Teacher-student interaction' (Dimension 6) contains two learning-centred beliefs (B/a and B) which differ in the purpose of the interaction: clarifying understanding (D6 B/a) and negotiating meaning (D6B), respectively. In the original framework the distinction between the two beliefs lay between Orientation III and IV; based on our findings the distinction was placed between Orientations IV and V in the new framework.

Finally, three of the original dimensions needed to be fine-tuned: the dimensions 'Nature of knowledge' (Dimension 4), 'Professional development' (Dimension 8), and 'Students' motivation' (Dimension 9). In the original framework these dimensions consisted of two dichotomous beliefs, while in our data more than two constituent beliefs could be extracted within these dimensions. These refinements resulted in a sharper demarcation between the orientations. Below we describe the newly emerged beliefs within these dimensions, including those within the new dimension 'Creation of a conducive learning environment'.

Dimension 4: Nature of knowledge

Some educators viewed knowledge as externally constructed, described as a 'database', as necessary 'tools' of factual knowledge, coming from outside sources like books or literature, and not linked to the reality of patient care (coded as D4A).

Interviewer: *'What is knowledge in your discipline?'*

Participant: *'Information about disease, identification, prognosis, treatment of disease.'* (D4A; S03)

We uncovered a further distinction between the view of 'knowledge being externally constructed'. Some participants viewed knowledge as consisting of facts only, while others emphasised that this knowledge, even though externally constructed, should be related to patient care by the educator. They believed that the educator should explain how the 'factual knowledge' can be used (D4A/b):

First of all you have basic factual knowledge... I would say the next step is understanding why it is like that, so a sort of reflection on the knowledge and why it is important to possess this knowledge ... that you have to make a kind of doctor's reflection on it... like when the patient comes with this or that pain or this or that complaint, what is behind it (in basic knowledge),... the focus lies for me on the first steps:... that's how it is and that's how you need to look at it. (D4A/b; L12)

Participants with a learning-centred belief orientation described knowledge as personalised, 'dynamic' and as 'change', coming from experience and exposure to the professional reality or to professional role models, with a focus on its application. In this view, competencies such as collaboration, communication, and clinical reasoning are seen as elements of knowledge to be learned, and they become relevant learning goals (coded as D4B).

Well, it [knowledge in the discipline, ed.] is a lot of different things; there is some factual knowledge, there is also knowledge about aspects of what it means to be a human being, and a human being who is suffering, and a human being who has a disease and all the implications of that. That's not really factual knowledge; it's experiential knowledge in some ways, that is a little difficult to identify specifically. It's more amorphous. (D4B; S02)

Dimension 7: *Creation of a conducive learning environment*

Educators within the most teaching-centred belief orientations did not stress the importance of creating a conducive learning environment or formulated this in a negative way. For example, they described giving room to ask questions, which theoretically would promote learning, and then talked about the 'stupidity' of a question (D7A). Within the most learning-centred orientations educators explained that they created a positive, personal relationship with individual students to enable them to learn; the focus is on the learning process (D7B):

I think it's just really willingness to make the learning fun. You know the students, they like teachers who allow them to learn something new. If teachers just are trying to be nice and popular, they see through that. (D7B; S02)

In the teaching-centred orientation with learning-centred aspects (Orientation III) the aim of the educator when creating a conducive learning environment is to make students feel at ease (D7A/b), with a focus on the group of students as a whole; in the learning-centred orientation with teaching aspects (Orientation IV), the aim is to help students in their understanding with a focus on the person of the individual student (D7B/a):

'To create an atmosphere in which students feel at ease ... to freely ask me questions.' (D7A/b; L12)

'I know them as an individual, I care about them and they have a safe place where they can respond.' (D7B/a; S12)

The main difference between D7B/a and D7B is the focus of the educator, which is on the person of the student (D7B/a) or on the learning process (D7B), respectively.

Dimension 8: *Professional development*

Professional development within a medical context can be described as the development from the role of a student to that of a doctor. In the teaching-centred belief orientations the focus of the teaching is on the academic discipline and less on the professional development of the student. Thus, although some educators recognised the relevance of certain professional competencies, the teaching of these competencies was not primarily aimed at the development of students. The educators with a belief Orientation I or II believed that students acquired some awareness of these competencies by the educator telling students about them (D8A).

What I always do is that now and again in the small group is I bring in general knowledge about our healthcare and the market forces ... I always try to bring in a few examples. Because I find that students should have a broader helicopter view of healthcare. (D8A; L05)

The educators with belief Orientation III were aware that a variety of professional competencies such as clinical reasoning, collaboration, communication, and professional attitude are important. For these educators, a small group is an appropriate environment to learn these competencies, or they believe some of these competencies can be demonstrated by being a role model (D8A/b).

...I think that it's important to work together in small groups; co-operation between students is important ... that is important for doctors because they work in teams. So learning to work together, and learning to accept the roles that other people play, because there are often people who take the lead and there are people who hang back. That's all part of it. (D8A/b; L12)

In the learning-centred belief orientations the focus of the teaching is on the development of the student. Educators within Orientation V and VI described the student's professional development as an educator's responsibility and emphasised the importance of fostering the learning or development of the students (D8B). Most participants holding this belief refer to multiple physician roles. In addition to being a clinical expert, the professional physician should also be a communicator, collaborator, leader, health advocate, and scholar (showing qualities such as critical thinking and lifelong learning) [37].

that if one runs a small group successfully to where people don't see that they necessarily must be the mirror image of each other but they capitalize on each other's strengths, then they actually can begin to be learning what they are going to do for a lifetime. So the power of the small group is the power of the professional behaviour that you hope continues forever; especially around team-work and respect – the whole... (D8B; S05)

Educators within Orientation IV believed that they had an important role in the professional development of students, but were less outspoken about their responsibility in this process (D8B/a).

For the student, I think that what you especially want is that he really participates [in a workgroup]. Maybe it is also something that develops. It would of course be fantastic if after four years, students could take on the role of teacher. One of the things is of course teamwork in the hospital or another place where you work later; so these are skills which are totally essential. (D8B/a; L01)

Dimension 9: *Students' motivation*

In the two most teaching-centred orientations (I and II), educators focused on their own interests or enthusiasm, and believed that, consistent with their belief in transmitting knowledge, they also have to transmit their own motivation to the students (D9A):

I think [teaching] is trying to transmit information in a way that fosters interest in the audience. I think your goal ought to be to generate some excitement, to be excited about what you are teaching and to be an effective communicator so you can share your excitement, your passion, and generate some enthusiasm in the audience. (D9A; S07)

In Orientation III, educators described their awareness of students' intrinsic motivation (D9A/b), acknowledging, for example, the enthusiasm of students. In Orientation IV educators were aware of the *individual differences* in students' intrinsic motivation (D9B/a). These educators used phrases like wanting to learn about what the student is interested in, recognising where the student 'wants to get'.

If you consider that intrinsic motivation is most important, then those students who are intrinsically motivated will find their way themselves with a bit of help... I go along with what I think interests them. (D9A/b; L10)

try to find something about what's their driver, what makes them tick, what makes them excited, what makes them feel like it's worth coming to class. And for some it's problem-solving, for some it's knowing something no one else knows..., different reasons, and not assuming that all [reasons] have to be the same. (D9B/a; S12)

In the most learning-centred orientation (VI), educators described their responsibility to find out what makes the learning of the individual student exciting, to invest in the person of the student and his/her passion, and to foster the motivation and interest of the student with the goal of enhancing the learning (D9B):

What I know about adult learning is that they do best when they are focused on what is important to them, and so if they have identified their own specific learning objective, and we as the facilitator-teacher help them with that, then that is reinforcing and motivating and that sort of thing. (D9B; S11)

Results of quality strategies

Comparison of the classification of the independent research-assistant with that of the authors resulted in a high inter-rater reliability of 0.85 (Cohen's Kappa). For the two transcripts, out of a total of 18 interview transcripts that were rated differently, final consensus was reached. This result validates the framework, supporting that it is not dependent on the perspective of a single educational researcher.

Comparison of the three sets of groups of participants generated the following results: The belief orientations of educators at SUSM were significantly more learning-centred than the belief orientations of LUMC educators ($p = 0.015$). Additionally, those teaching clinical topics proved to have a more learning-centred belief orientation compared to those teaching basic science topics ($p = 0.029$) (see Table 2).

Table 2
Belief orientation of medical educators specified by faculty, teaching topic and educational role

		Belief orientation						<i>p</i> value*
		I	II	III	IV	V	VI	
Faculty	LUMC	1	3	5	4	0	0	0.015
	SUSM	0	4	0	1	2	6	
Teaching topic/ educational role	Basic Science	0	7	2	0	0	1	0.029
	Clinician	1	0	2	3	1	3	
	Administrator	0	0	1	2	1	2	

**p* values are based on comparisons using Chi-squared test for trend. Data with *p* values below 0.05 are shown in bold

The three administrators holding a belief Orientation III or IV (see Table 2) are from the LUMC, while the three administrators holding a belief Orientation V or VI are from SUSM. These data imply that none of the educators shows a more learning-centred orientation than the administrators from that medical school, namely a belief Orientation IV for the LUMC, and a belief Orientation VI for the SUSM. The number of administrators is too small to quantify this relationship, but the findings are in line with the hypothesis that the belief orientations of administrators in educational leadership positions influence the belief orientations of the educators at their respective medical schools.

These comparisons showed that the new framework can distinguish between the belief orientations of different groups of medical educators.

As a final quality strategy we provide a *thick* description of two maximally contrasting belief orientations (Orientations I and VI). Only one educator in our study displayed an Orientation I; he is a clinician from LUMC. Of the six educators who displayed an Orientation VI we selected the basic science educator to illustrate how a teacher with a learning-centred belief orientation teaches basic science topics. His educational beliefs contrasted with the beliefs of the other basic science educators. This educator worked at SUSM.

Dr A: teaching-centred orientation I: *Imparting information*

In the narrative of Dr A, the spotlight is on the teacher, who puts a lot of effort into his teaching. What highlights Dr A's belief about teaching is his desire to 'transfer knowledge', which he sees as a tool, and is first introduced from 'hardware', such as books or electronic information. He emphasises the importance of memorising factual knowledge, as this is a prerequisite for clinical reasoning. 'You can look everything up, but I don't think it works like that in practice'. In his teaching he expects students to be well prepared and checks this by asking questions, for example, about anatomy. Students should be 'committed,

diligent, and well-behaved. He is worried about the attitude and lack of motivation that he observes in some students. He aims to make students take responsibility for working hard by being provocative. For example, he presents a patient case with a bad outcome due to a medical error. Next to the importance of knowledge transfer, teaching to him means providing students with tips and tricks about how to drill the facts. He wants to be a role model, hoping that by demonstrating his own level of knowledge the students will be motivated: *'(...) what you show them is that you know a lot. It would be very nice if that is motivating for the students. To ensure that you know a great deal about a certain subject.'* A good teacher to him is someone who determines his own teaching goals and achieves them. When asked about what students bring to the learning process, he responds that he is often disappointed that students are so unresponsive. Yet he tries to convey his own motivation on the subject and in this way generate enthusiasm among the students.

Dr B: learning-centred orientation VI: *Negotiating meaning*

In the narrative of Dr B students are the main characters, and the focus is on their learning process. He has several aims which he hopes to achieve through his teaching. First that *'they learn the material'* which is integrated into patient presentations, as *'they should be able to apply the material to patient care'*. Second, he wants *'to introduce students to the idea of how they can learn in the future'*. Therefore he spends a significant part of his course analysing medical articles so that students can read medical literature and understand its implications for patient care. Third, he aims to teach students to be sceptical and critical and *'to understand that the literature, the professor, or commonly accepted wisdom can be wrong. So they get a lot of credit for pointing out that I'm wrong.'* His assessments reflect the importance of being able to apply what they have learned: *'The idea is they have to be able to apply what they learn in the class to the patients and also to be able to extract information from the journal articles that they can apply. [...] If they try to memorise the course notes and take our final exam they won't do very well, because we ask for synthesis in our final exam.'* Dr B sees teaching as *'an alliance, a collaboration between the student and the teacher to learn'*. Knowledge for him is not only about the basic science material, but also about taking care of patients. He emphasizes that a lot of reciprocal teaching occurs in his small group setting, and that by splitting the group up into pairs the teaching is *'completely interactive'*. He is clear that creating a supportive learning environment is a prerequisite for the learning to occur. Thus he emphasises the importance of continuity in the learning process, with the same teacher over a longer period of time. *'They have to learn to trust me, that I won't make fun of them.'* He puts effort into trying to make the learning fun, for example by using a competition or games. He sees it as his responsibility to figure out how to engage the students: *'They come predisposed to learning and the reason is they have a very high incentive to learn because they are really concerned about preparing themselves to take care of patients in the near future and so they have a tremendous incentive to learn. But they're always demanding to know if it is meaningful or relevant.'*

The narratives as well as the results of the other implemented quality strategies provide support for the utility of the new framework.

Discussion

Our results confirm the relevance of the structure of the original Samuelowicz and Bain framework in the field of medical education. However, significant changes were required to adapt the framework to a medical education context. We will successively discuss the necessary changes in the belief dimensions, followed by the consequences for the belief orientations and for the boundaries between the belief orientations.

Of the nine original dimensions only two remained unchanged; one dimension disappeared, a new dimension was identified, and five dimensions needed substantive adaptations or refinements. We explicate the major changes here. Within the dimension 'Nature of knowledge' (Dimension 4), we made a distinction between two beliefs about knowledge as being 'externally constructed'. In the teaching-centred orientation with learning-centred aspects (A/b), the medical educators view knowledge as externally constructed, but are also aware that the link to its applicability in the medical profession is important. This awareness may be due to the medical education context, in which most educators are often involved in clinical work. This most likely encourages educators to link content knowledge to the practice of patient care. Relating meaning to a social reality is an important aspect of the epistemological view of knowledge as being co-constructed [38, 39]. The other relevant aspect of this epistemological view is that a learner conceptualises meaning from interaction with others. This view is also reflected in our data in the belief that the goal of teacher-student interaction is to negotiate meaning (D 6B).

Within the dimension 'Students' existing conceptions' (Dimension 5) we did not find the belief that students' misunderstandings should be prevented, as described in the original framework. In our findings, medical educators instead emphasise building on students' preconceptions to develop expertise, and sometimes also learning from students' conceptions themselves. We hypothesise that this difference might reflect a more current, general awareness that not all preconceptions are misconceptions [40].

The belief dimension concerning the professional development of the student (Dimension 8) has been extended from two to four distinct beliefs. Although we can imagine that educators in other disciplines, which have a focus on other professions, also show clear beliefs about the development of students, we suppose that this extension is due to the context of medical education. Other medical education studies have highlighted beliefs about the professional development of the student. However, Stenfors-Hayes et al. [41], who compared the beliefs of medical educators working in a preclinical versus clinical context, uncovered the emphasis on the professional development of the students only within the clinical context, which contrasts with our findings. In two other studies [28, 42] beliefs about professional development are presented as separate from beliefs about teaching and learning. In our framework, however, beliefs about professional development represent one dimension that is an integral aspect of an educator's belief orientation.

The addition of the constituent beliefs of the Dimension (9) 'Students' motivation' may be due to our explicit questions on small group teaching during the interviews. A small group enables an educator to pay attention to the individual student's intrinsic motivation, which is much more difficult in the setting of large-scale lectures.

Interestingly, the new dimension 'creation of a conducive learning environment' (Dimension 7) did not occur in the original framework. We assume that the small group focus during the interviews may also be the reason for identifying this new dimension. In this context, in which the student is assumed to be actively involved, it is likely that an educator is more aware of the importance of a supportive learning environment. Other medical education literature

highlights the importance of 'nurturing' or 'respecting' students [42, 43]. However, only a single study classifying educational beliefs, conducted in the context of higher education [11], also recognised that a conducive learning environment is a relevant aspect of the educational beliefs of educators.

The refinements of these dimensions as well as the development of the new dimension 'Creation of a conducive learning environment' add to the quality of the new framework, because the expansion of the constituent beliefs enables a sharper demarcation between the adjacent belief orientations. In the original framework the distinction between some adjacent belief orientations was based on only one belief dimension. Our new framework extends this to at least two dimensions, which makes it possible to determine a medical educator's belief orientation more reliably.

Significantly, these refinements create a more clearly defined boundary between teaching-centred and learning-centred orientations. In the original framework the two adjacent orientations on either side of this boundary (Orientation III and IV, see Table 1) still shared two common beliefs, whereas in our new framework for medical education only one out of nine beliefs is shared between these two orientations. This is significant as it underlines the sharp boundary between a teaching-centred and learning-centred orientation, and reinforces Samuelowicz and Bain's notion [14] that transition from a teaching-centred to a learning-centred belief orientation means a profound shift in which, according to the new framework, eight out of nine beliefs would have to change. As the other adjacent belief orientations have three to seven beliefs in common, the differences between these orientations are more subtle, suggesting that these orientations can be seen as orientations within a continuum. These boundaries may also be easier to cross. In Kember's review article on teaching beliefs [6], a transitional belief orientation is proposed that would bridge the teaching-centred versus learning-centred orientations. However, our findings, like those of Kember and Kwan [8] as well as Samuelowicz and Bain [14], do not support this bridging belief orientation.

Finally, the disappearance of the dimension 'Control of content' led to the absence of the original framework's most learning-centred belief orientation (Orientation VII). Central to this orientation is the belief that students should be in control of the learning content. We attribute this disappearance to our preclinical context. This finding is consistent with the findings of Samuelowicz and Bain [13, 14] who identified this belief exclusively within a postgraduate teaching context.

One other finding merits comment: half of the medical educators in our study showed a teaching-centred belief orientation. This was surprising given that they had been working within a student-centred curriculum for at least a decade and were experienced and deeply involved in teaching. Obviously, in a student-centred curriculum one would assume a learning-centred orientation to be most effective. On closer inspection, however, the majority of LUMC participants held a teaching-centred belief orientation, while the majority of SUSM participants held a learning-centred belief orientation. We predicted a difference in belief orientation due to a more intensive and widespread faculty development programme at SUSM. However, other differences between the two medical schools might play a role, such as a difference in the admissions policy for new staff or in the medical school's mission. Our findings underline that the development from a teaching-centred to a learning-centred belief orientation does not automatically take place when a curriculum is innovated towards student-centredness [44]; intensive faculty development interventions may be required.

Limitations

The data for this study have been collected at two research-intensive medical schools which were both innovating towards a more student-centred curriculum prior to the study. We selected these schools intentionally to identify a larger variety of beliefs and to assess the ability of the new framework to distinguish between two school contexts. This may limit the generalisability of our results. Research conducted in schools with a longer tradition of student-centred curricula may reveal further refinements of learning-centred beliefs.

We deliberately selected educators with long-standing teaching experience. This may have created a bias in the distribution of the belief orientations. It is possible that less experienced educators would have displayed more teaching-centred belief orientations. However, all belief orientations are represented in our study.

In addition, the data were gathered a decade ago. It is possible that the beliefs of medical faculty have changed since then, due to new curriculum changes or ongoing faculty development interventions. Yet, the original framework was developed a decade before we conducted our study, and we conclude that in those ten years the overall structure of the framework remained the same. Moreover, our data show that even a decade after the innovation to a student-centred curriculum, a substantial number of educators still hold on to a teaching-centred belief orientation. Thus, we expect that the proposed framework continues to be applicable.

Finally, we intentionally focused on the preclinical teaching context. Therefore, we need to be careful in drawing conclusions from our findings to other contexts. Indeed, a postgraduate setting, as opposed to our preclinical context, might uncover more learning-centred belief orientations, consistent with the findings of Samuelowicz and Bain [13, 14].

Implications for teaching and future research

The sharp division between the teaching-centred and learning-centred belief orientations in the framework implies that a change from a teaching- to a learning-centred orientation is a major transition. In student-centred curricula, one way that faculty development programmes could support educators in making this transition is by helping them to become aware of their beliefs. The new framework can make these beliefs more explicit and can encourage medical educators to revisit their beliefs about teaching, learning, and knowledge. The framework's dimensions can be used as an instrument for reflection and discussion about a medical educator's educational beliefs. The adaptations and extensions that this framework provides are those areas that are relevant to the context of student-centred medical education. Reflecting on how to determine which knowledge is relevant to be learned, how to create a positive learning climate, how to help the student in their professional development, and how to foster motivation in the student, are of major importance for the quality of our education of future health professionals.

Further research is needed to investigate the extent to which the beliefs of medical educators can change and develop towards learning-centredness. For such a study, the presented framework can provide a useful instrument.

Conclusions

The study reported here was undertaken to describe and classify the beliefs of medical educators about teaching, learning, and knowledge in medical education. Insight into these beliefs is important for medical schools to improve the quality of education and can provide input for faculty development. Our findings confirm the relevance of the structure of the original Samuelowicz & Bain beliefs framework, developed within higher education research [14], to the field of medical education. Although the overall structure of the original framework is preserved, several refinements have been proposed herein and were necessary to align the framework to a medical context. We ascribe the new dimension labelled 'Creating a supportive learning environment' in our explicit questions on a small group teaching setting during the interviews. This factor, in our opinion, also explains the addition of the constituent beliefs in the Dimension 'Students' motivation'. In addition, the refinement of the beliefs about the 'Nature of knowledge' and 'Students' professional development' are related to the specific character of the medical education context, with its focus on clinical knowledge and professional development. The newly refined beliefs enable a more comprehensive description of the belief orientations of medical educators. As in the original framework, the belief orientations can be arranged on a continuum from teaching-centredness to learning-centredness. The new framework sharpens the boundary between teaching-centred and learning-centred orientations, underlining the major transition from a teaching-centred to a learning-centred belief orientation. With the adaptations proposed herein, the new framework is a more contemporary instrument for faculty development to enable medical faculty to reflect on and revisit their beliefs about teaching, learning, and knowledge.

Abbreviations

LUMC

Leiden University Medical Centre

SUSM

Stanford University School of Medicine

Declarations

Ethics approval and consent to participate

This study was granted an ethics waiver by the Medical School Ethics Committee of the LUMC (reference C15.033/SH/sh). The same committee advised that formal written informed consent was not required; all participants were invited by email or telephone by the first author, who emphasised that participation was voluntary and anonymous, and gave orally informed consent. Similarly, the study was deemed as 'not involving human subjects research' by the Stanford University Human Subjects Committee and was exempt from human subjects oversight. All methods were carried out in accordance with relevant guidelines and regulations.

Consent for publication

Participants agreed to the interview being recorded and to data collected being used anonymously within academic publications.

Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due to promised anonymity of the participants, but are available from the corresponding author on reasonable request and with permission of the participants in question. The generated codebook is available upon request.

Competing interests

The authors declare that they have no competing interests.

Funding

No funding was received for this study.

Authors' contributions

Ottenhoff- de Jonge was the major contributor to the study concept and design. Gesundheit enabled data collection at Stanford School of Medicine. Ottenhoff- de Jonge collected the data and analysed them together with Van der Rijst and Van der Hoeven. The first draft of the manuscript was written by Ottenhoff- de Jonge and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Acknowledgements

The authors wish to thank the medical educators who took part in this study, Prof Dr Jelle Goeman and Dr Bart Mertens for their advice on statistics, and Prof Dr Yvonne Steinert for her worthwhile feedback on the manuscript.

References

1. Pajares MF: Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of educational research* 1992, 62(3):307-332.
2. Trigwell K, Prosser M: Changing approaches to teaching: A relational perspective. *Studies in Higher Education* 1996, 21(3):275-284.
3. Trigwell K, Prosser M, Waterhouse F: Relations between teachers' approaches to teaching and students' approaches to learning. *Higher education* 1999, 37(1):57-70.
4. Williams RG, Klamen DL: See one, do one, teach one--exploring the core teaching beliefs of medical school faculty. *Medical teacher* 2006, 28(5):418-424.
5. Visser-Wijnveen GJ, Van Driel JH, Van der Rijst RM, Verloop N, Visser A: The relationship between academics' conceptions of knowledge, research and teaching--a metaphor study. *Teaching in Higher Education* 2009, 14(6):673-686.
6. Kember D: A reconceptualisation of the research into university academics' conceptions of teaching. *Learning and instruction* 1997, 7(3):255-275.
7. Richardson V: The role of attitudes and beliefs in learning to teach. *Handbook of research on teacher education* 1996, 2:102-119.
8. Kember D, Kwan K-P: Lecturers' approaches to teaching and their relationship to conceptions of good teaching. *Instructional science* 2000, 28(5):469-490.
9. Verloop N, Van Driel J, Meijer P: Teacher knowledge and the knowledge base of teaching. *International Journal of Educational Research* 2001, 35(5):441-461.
10. Kember D, Gow L: Orientations to teaching and their effect on the quality of student learning. *The Journal of Higher Education* 1994, 65(1):58-74.
11. Postareff L, Lindblom-Ylänne S: Variation in teachers' descriptions of teaching: Broadening the understanding of teaching in higher education. *Learning and Instruction* 2008, 18(2):109-120.
12. Pratt DD: Five Perspectives on Teaching in Adult and Higher Education: ERIC; 1998.
13. Samuelowicz K, Bain JD: Conceptions of teaching held by academic teachers. *Higher education* 1992, 24(1):93-111.
14. Samuelowicz K, Bain JD: Revisiting Academics' Beliefs about Teaching and Learning. *Higher education* 2001, 41(3):299-325.
15. Light G, Calkins S: The experience of faculty development: Patterns of variation in conceptions of teaching. *International Journal for Academic Development* 2008, 13(1):27-40.
16. Samuelowicz K: Academics' educational beliefs and teaching practices. Griffith University Queensland; 1999.
17. Barnhoorn PC, Houtlosser M, Ottenhoff-de Jonge MW, Essers GT, Numans ME, Kramer AW: A practical framework for remediating unprofessional behavior and for developing professionalism competencies and a professional identity. *Medical teacher* 2019, 41(3):303-308.
18. Brody H, Doukas D: Professionalism: a framework to guide medical education. *Medical education* 2014, 48(10):980-987.
19. Cruess RL, Cruess SR, Boudreau JD, Snell L, Steinert Y: A schematic representation of the professional identity formation and socialization of medical students and residents: a guide for medical educators. *Academic Medicine* 2015, 90(6):718-725.
20. Frambach JM, van der Vleuten CP, Durning SJ: AM last page: Quality criteria in qualitative and quantitative research. *Academic Medicine* 2013, 88(4):552.
21. Kuper A, Lingard L, Levinson W: Critically appraising qualitative research. *BMJ* 2008, 337:a1035.
22. Prosser M, Trigwell K: Relations between perceptions of the teaching environment and approaches to teaching. *British Journal of Educational Psychology* 1997, 67(1):25-35.
23. Hennink MM, Kaiser BN, Marconi VC: Code saturation versus meaning saturation: how many interviews are enough? *Qualitative health research* 2017, 27(4):591-608.
24. Calkins S, Johnson N, Light G: Changing conceptions of teaching in medical faculty. *Medical teacher* 2012, 34(11):902-906.
25. Ho A, Watkins D, Kelly M: The conceptual change approach to improving teaching and learning: An evaluation of a Hong Kong staff development programme. *Higher Education* 2001, 42(2):143-169.
26. Postareff L, Lindblom-Ylänne S, Nevgi A: The effect of pedagogical training on teaching in higher education. *Teaching and teacher education* 2007, 23(5):557-571.
27. Knight AM, Carrese JA, Wright SM: Qualitative assessment of the long-term impact of a faculty development programme in teaching skills. *Medical education* 2007, 41(6):592-600.
28. Jacobs JCG: Conceptions of learning and teaching in teachers: in student-centred curricula in Medicine. 2015.
29. Lindblom-Ylänne S, Trigwell K, Nevgi A, Ashwin P: How approaches to teaching are affected by discipline and teaching context. *Studies in Higher education* 2006, 31(03):285-298.
30. Neumann R, Parry S, Becher T: Teaching and learning in their disciplinary contexts: A conceptual analysis. *Studies in higher education* 2002, 27(4):405-417.
31. Singer ER: Espoused teaching paradigms of college faculty. *Research in Higher Education* 1996, 37(6):659-679.
32. Jacobs JCG, Muijtjens AMM, Van Luijk SJ, Van der Vleuten CPM, Croiset G, Scheele F: Impact of institute and person variables on teachers' conceptions of learning and teaching. *Medical Teacher* 2015, 37(8):738-746.
33. Jacobs JCG, van Luijk SJ, van der Vleuten CP, Kusurkar RA, Croiset G, Scheele F: Teachers' conceptions of learning and teaching in student-centred medical curricula: the impact of context and personal characteristics. *BMC medical education* 2016, 16(1):244.
34. O'sullivan PS, Irby DM: Reframing research on faculty development. *Academic Medicine* 2011, 86(4):421-428.
35. Lueddeke GR: Professionalising teaching practice in higher education: A study of disciplinary variation and 'teaching-scholarship'. *Studies in higher education* 2003, 28(2):213-228.

36. Postareff L, Katajavuori N, Lindblom-Ylänne S, Trigwell K: Consonance and dissonance in descriptions of teaching of university teachers. *Studies in Higher Education* 2008, 33(1):49-61.
37. CanMEDS: Better standards, better physicians, better care [http://www.royalcollege.ca/rcsite/canmeds/canmeds-framework-e]. Accessed July 2nd 2019.
38. Saljo R: Learning in the Learner's Perspective. I. Some Common-Sense Conceptions. No. 76. 1979.
39. Tigchelaar A, Vermunt JD, Brouwer N: Patterns of development in second-career teachers' conceptions of learning and teaching. *Teaching and Teacher Education* 2012, 28(8):1163-1174.
40. Smith III JP, Disessa AA, Roschelle J: Misconceptions reconceived: A constructivist analysis of knowledge in transition. *The journal of the learning sciences* 1994, 3(2):115-163.
41. Stenfors-Hayes T, Hult H, Dahlgren LO: What does it mean to be a good teacher and clinical supervisor in medical education? *Advances in Health Sciences Education* 2010, 16(2):197-210.
42. Pratt DD, Arseneau R, Collins JB: Reconsidering "good teaching" across the continuum of medical education. *Journal of Continuing Education in the Health Professions* 2001, 21(2):70-81.
43. Taylor EW, Tisdell EJ, Gusic ME: Teaching beliefs of medical educators: perspectives on clinical teaching in pediatrics. *Medical Teacher* 2007, 29(4):371-376.
44. Jacobs JCG, van Luijk SJ, Galindo-Garre F, Muijtjens AM, van der Vleuten CP, Croiset G, Scheele F: Five teacher profiles in student-centred curricula based on their conceptions of learning and teaching. *BMC Med Educ* 2014, 14:220.

Additional File

Additional file 1: Samuelowicz & Bain Framework [14]

Dimensions		Teaching-centred orientations						Learning-centred orientations					
		I. Imparting information		II. Transmitting structured knowledge		III. Providing and facilitating understanding		IV. Helping student develop expertise		V. Preventing misunderstanding		VI. Negotiating understanding	
1	Desired learning outcomes	Recall of atomised information	A	Reproductive understanding	A/b	Reproductive understanding	A/b	Change in ways of thinking	B	Change in ways of thinking	B	Change in ways of thinking	
2	Expected use of knowledge	Within subject	A	Within subject for future use	A/b	Within subject for future use	A/b	Interpretation of reality	B	Interpretation of reality	B	Interpretation of reality	
3	Responsibility for organising or transforming knowledge	Teacher	A	Teacher	A	Teacher shows how knowledge can be used	A/b	Students & Teacher	B/a	Students	B	Students	
4	Nature of knowledge	Externally constructed	A	Externally constructed	A	Externally constructed	A	Personalised	B	Personalised	B	Personalised	
5	Students' existing conceptions	Not taken into account	A	Not taken into account	A	Not taken into account	A	Not taken into account	A	Used to prevent common mistakes	B/a	Used as basis for conceptual change	
6	Teacher-student interaction	One-way; Teacher à students	A	Two-way to maintain students' attention	A/b	Two-way to ensure/ clarify understanding	B/a	Two-way to negotiate meaning	B	Two-way to negotiate meaning	B	Two-way to negotiate meaning	
7	Control of content	Teacher	A	Teacher	A	Teacher	A	Teacher	A	Teacher	A	Teacher	
8	Professional development	Not stressed	A	Not stressed	A	Not stressed	A	Stressed	B	Stressed	B	Stressed	
9	Interest and motivation	Teachers'	A	Teachers'	A	Teachers'	A	Students'	B	Students'	B	Students'	

Additional file 2: Interview guide

	Main questions	Supplementary questions
Questions related to teaching	Q 1 What do you aim to achieve through your teaching?	. Do you think you achieve your aims? If not, what happens in practice? . What, if anything, does prevent you from achieving your aims?
	Q 2 What is teaching?	. Do you think about teaching in this way in all situations? If not, what are other ways in which you think about teaching? . What is your main concern when teaching?
	Q 3 Does the format of the small group influence your teaching? (as opposed to large group lectures/one-on-one teaching). How?	
	Q 4 What do you see as your role and as your students' role in the teaching and learning process?	. What are your and students' main responsibilities? . What do you do apart from telling students about something?
	Q 5 What do students bring to the learning process?	
	Q 6 What makes somebody a good teacher?	. What, if anything, do you see as main obstacles to good teaching?
Questions related to knowledge	Q 7 What is knowledge in your discipline?	. Where does knowledge come from? . Are there different types of knowledge? . Do you teach different types of knowledge in different ways? How? In particular, how do you teach relationship between theory and practice? . Do you ever modify your small group-teachings and if so, what does influence the changes you make?
Questions related to learning	Q 8 What is learning?	. What does it mean to learn?
	Q 9 Does the format of the small group influence the students' learning? How?	
	Q 10 How do you know that your students have learned something?	. What are the signs that students have learned something? . What distinguishes a competent/good student from a poor student? . If you asked your students at the end of the course 'what have you learned from this course?' what would you like your students to say?

		. Do you, and if so how, communicate to students what kind of learning you value?
	Q 11 Do you assess what students have learned through the small group teaching? If so, how?	. What does happen in the teaching process that prepares students for this assessment?
	Q 12 What were the most important ways in which your learning as a student was enhanced?	. How were you made responsible for your own learning?
Question linking teaching and students' learning	Q 13 We have talked about teaching and learning; does your teaching influence student learning? How?	. What do you think has the biggest influence on students' learning? . What is the most important thing you do in small group teaching that influences ways in which students learn?